V[illegible] [illegible] 1941 NUMBER 5

[illegible] DEPARTMENT OF COMMERCE
[illegible], Secretary
WEATHER BUREAU F. W. Reichelderfer, Chief

MONTHLY WEATHER REVIEW

MAY 1941

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CORRECTIONS

MONTHLY WEATHER REVIEW SUPPLEMENT No. 46: The serial number [illegible].

MONTHLY WEATHER REVIEW, January to April, inclusive, 1941, for corrections to table 3 of Solar Radiation Observations, see page [illegible] of this issue.

MONTHLY WEATHER REVIEW

Editor, EDGAR W. WOOLARD

VOL. 69, No. 5
W. B. No. 1329

MAY 1941

CLOSED JULY 3, 1941
ISSUED JULY 30, 1941

DAILY SOLAR RADIANT ENERGY AT THE EXTERIOR OF THE ATMOSPHERE

By ROBERT E. KENNEDY

[U. S. Bureau of Reclamation, Denver, Colo., March 1941]

A graph of average daily air-mass values was published in the MONTHLY WEATHER REVIEW for November 1940, page 302; its practical use involves, among other things, the total daily solar radiation on a horizontal surface at the exterior of the atmosphere, denoted by I_0 in equation (2) of the article. Tables from which I_0 may be computed have been available for over 50 years, but their form is not very convenient. Figure 1 is here offered, which graphically gives the data, directly in B. t. u. per square inch per day; it is arranged in the same form as the air-mass graph. To change to calories per square centimeter per day, multiply by 39.06.

This graph is based on a solar constant of 1.94 calories per square centimeter per minute; it takes into account the variations of the earth's radius vector, and is applicable to any place in the Northern Hemisphere for any day of the year by entering with the latitude of the place and the declination for the day. It is not applicable to the Southern Hemisphere.

Its construction was based on the computation of 134 points. It was checked at convenient places by reference to the tabulation first published in the *Annual Report of the Chief Signal Officer*, 1885, Part 2, page 427, by Wm. Ferrel, and now available in several publications of the Smithsonian Institution (e. g., Table 688, p. 556, in the Eighth Revised Edition, First Reprint, June 1934, *Smithsonian Physical Tables*, with the voluminous title: "Mean intensity J for 24 hours of solar radiation on a horizontal surface at the top of the atmosphere and the solar constant A, in terms of the mean solar constant A_0, at the earth's mean distance from the sun.")

The construction of this graph was much simpler and more straightforward than that of the air-mass graph. The cosine of the zenith angle measures the component of the solar ray normal to a horizontal surface. The total daily intensity is proportional to the sum of these cosines. The average cosine for either the day or the half day is equal to the area under the cosine curve divided by the hour angle from noon to sundown. Using the equation (1) and the terminology of the previous article, we have

$$\cos Z = a + b \cos t;$$

$$\text{Area under cosine curve} = \int_0^t (a + b \cos t)dt = at + b\sin t;$$

$$\text{Average daily } \cos Z = a + \frac{b}{t} \sin t.$$

To obtain the daily total, this is multiplied by the solar constant, the number of minutes of daylight, and the reciprocal of the earth's radius vector squared. It is divided by 39.06 to convert to B. t. u. per square inch per day. To check with the Ferrel table, or to use the table in case it is preferred to a graph, multiply the tabulated values therein by $\frac{1.94 \times 1440}{39.06} = 71.5$.

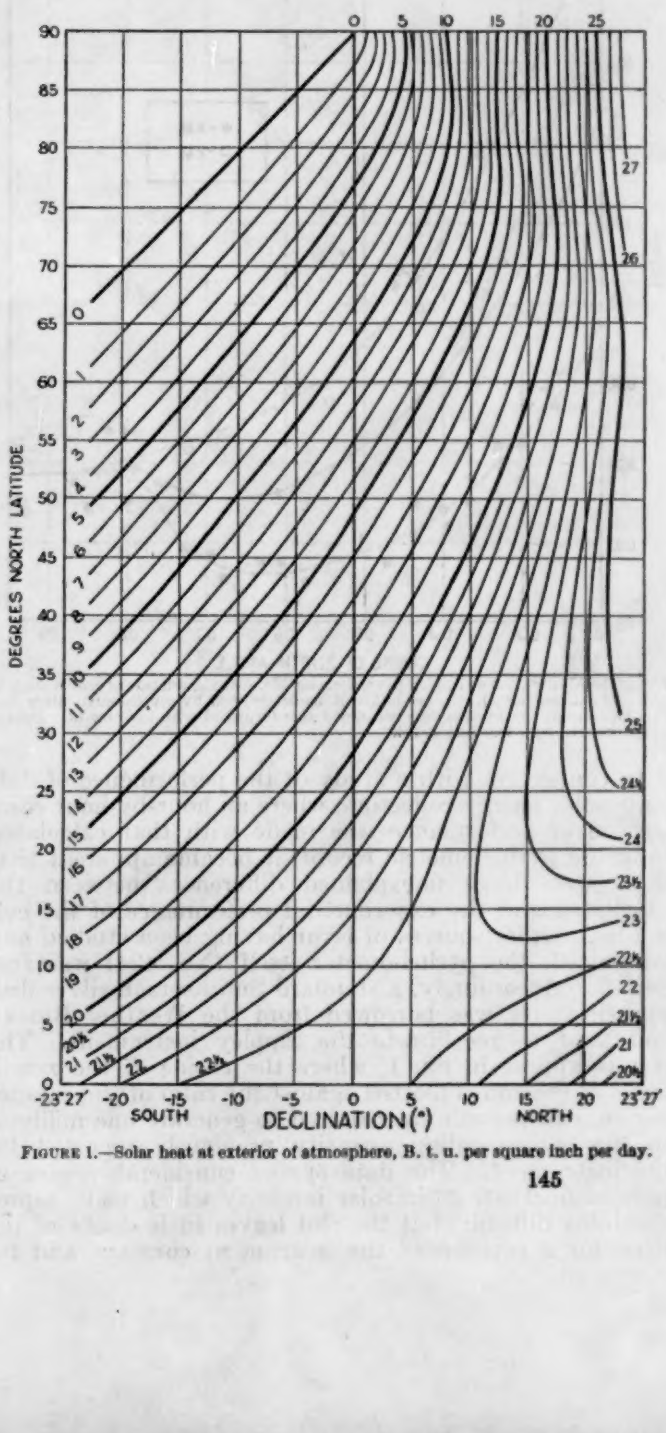


FIGURE 1.—Solar heat at exterior of atmosphere, B. t. u. per square inch per day.

THE CHARACTERISTICS OF THE EPPLEY PYRHELIOMETER

By BYRON B. WOERTZ (Massachusetts Institute of Technology) and IRVING F. HAND (U. S. Weather Bureau),* March 1941

The Eppley pyrheliometer is so widely used for the measurement of the intensity of total solar and sky radiation on a horizontal surface that a knowledge of its limitations should be of interest. In connection with the Cabot Solar Energy Utilization Program at Massachusetts Institute of Technology, it has been necessary to obtain an accurate continuous record of solar radiant energy; and an Eppley instrument has been used, the characteristics of which have been studied in considerable detail to assure maximum accuracy. It is the purpose of this article to present some of the results of that study as a guide to others interested in minimizing errors of measurement.

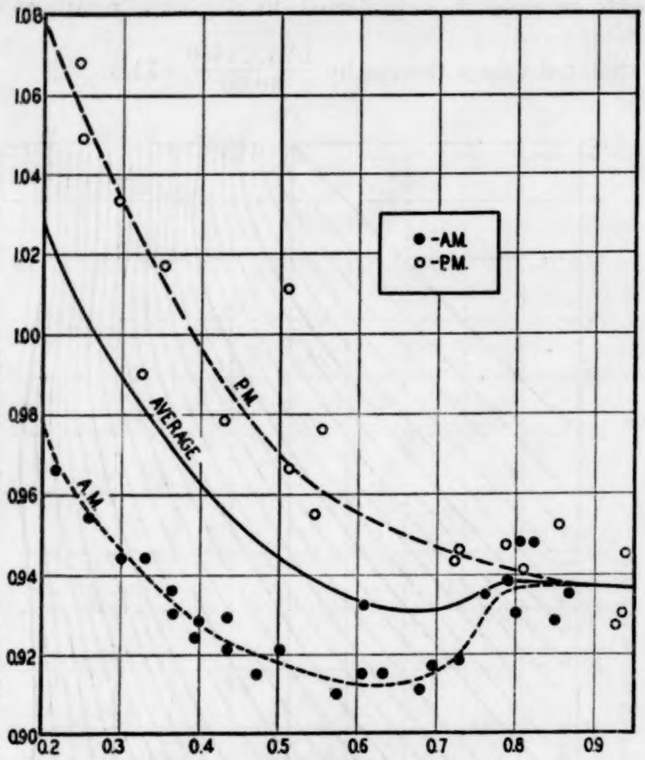


FIGURE 1.—Calibration of Eppley pyrheliometer No. 434: the relation of zenith angle to ratio of calories per sq. cm. per millivolt, as determined by Smithsonian silver disk pyrheliometer, to corresponding constant factor furnished with instrument. Date of experiments, June 7 to July 3, 1940.

In connection with a study of the performance of flat-plate solar energy collectors, where an hour-by-hour comparison of performance was made with that calculated from the pyrheliometric record, it became apparent that there were large unexplained differences between the calculated and the experimental performance of the collectors. Other sources of error having been studied and minimized, the pyrheliometer itself (No. 434) was suspected. Accordingly, a standard Smithsonian silver disk pyrheliometer was borrowed from the Weather Bureau and used to recalibrate the Eppley instrument. The results appear in fig. 1, where the cosine of the zenith angle of the sun is plotted against the ratio of the calories per sq. cm. per minute required to generate one millivolt to the corresponding quantity previously reported for the instrument. The data spread considerably, due in part to fluctuations in solar intensity which make reproducibility difficult; but the plot leaves little doubt of the need for a revision of the instrument constant and for the use of an instrument constant which is a function of zenith angle in order to obtain accurate data. Although normal precautions had been taken to mount the instrument in a horizontal position by sighting over a long spirit level, fig. 1 gives evidence of an effect of time of day (whether morning or afternoon), which might be due either to variations in the bulb glass or to lack of horizontality of the receiver disk. To determine more definitely whether the cosine of the angle of incidence of the solar beam on the instrument was the sole factor in obtaining the instrumental constant, a new experiment was undertaken.

A 1,000-watt projection bulb was mounted on a framework, which was in turn mounted equatorially with the pyrheliometer at its center. By this means the projection-bulb could be made to imitate in detail the sun's position at any time of day or year. A series of readings of the Eppley instrument was obtained, with elimination of the small effect of fluctuating voltage on the brightness of the projection-bulb by taking every other reading with the bulb in a certain standard overhead position and expressing all other readings as a ratio to the reading in the standard position. The data obtained were plotted as response of the instrument versus time of day for each of several "declinations" of the "sun." The resulting curves were smooth enough to indicate no particularly bad spots in the pyrheliometer bulb, but asymmetrical to an extent which could be explained by assuming that the pyrheliometer surface was about 1.5° off horizontal, an amount which cannot be detected by the eye because of the small size of the surface and the fact that its plane does not coincide with the plane of the top of the shell in which it is mounted. Making this correction and dividing all the responses by the cosine of the zenith angle, one obtains the relative response of the instrument per unit of intercepted energy. When the reciprocal of this value, proportional to calories per sq. cm. per min. per millivolt, is plotted against the cosine of the zenith angle, figure 2 is obtained. (The absolute height of the curve was established by making the average of all points corresponding to cosine of zenith angle greater than 0.6 equal to the average in the corresponding region of figure 1; for some reason, probably a small error in "declination" of the "sun," the points for −9.75° declination were decidedly too high, as can be seen in figure 2, and they were therefore ignored when the solid curve was drawn through the points.) Figure 2 is in reality a measure of the reproducibility of an Eppley instrument, inasmuch as the deviations cannot be explained by any error in potentiometry or fluctuations in intensity of source. The deviations of 1 percent or so (in the flat part of the curve) from the smooth solid curve are most probably due to local imperfections in the bulb and represent deviations for which it is impractical to allow in using the instrument. The absolute shape of the solid curve in figure 2 may differ somewhat from a similar curve obtained using sunlight itself, inasmuch as the change in absorptivity of a black surface, which undoubtedly accounts for the curvature, may be somewhat different for solar radiation and for the longer wave-length radiation from a 1,000-watt bulb.

The experience with the 1,000-watt bulb emphasized the need for an alignment technique better than that obtainable by visual observations of the pyrheliometer, since the data of figure 2 would have been much more widely spread if the instrument had not been corrected for the

*At various times H. E. Miller and Mrs. H. F. Cullinane assisted in obtaining data.

small tilt. Accordingly, two spirit levels were affixed (at right angles to each other) to the base of the instrument, which was then leveled by the following technique: a piece of plate glass was leveled to an accuracy of about 0.1° with a good quality spirit level. The Eppley instrument was then placed on the glass, and the 1,000-watt bulb was mounted 18 inches away at an altitude of about 10° above the horizon of the pyrheliometer. The instrument was then rotated about its center while readings of its response were taken. (Care must be exercised not to let the center of the disk move laterally more than one-eighth inch during the rotation to prevent an error of 1 percent in the readings.) By trial and error the pyrheliometer was leveled until this process of rotation produced a minimum

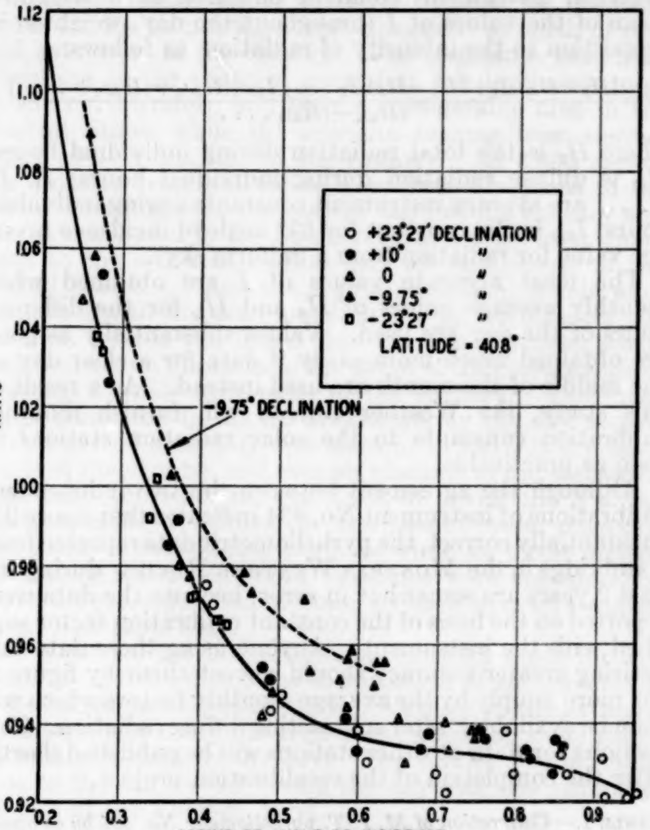


FIGURE 2.—Ratio of true calories per sq. cm. per millivolt (as a function of angle of incidence) to the calibration constant furnished with pyrheliometer. Data obtained using a 1,000-watt projection bulb equatorially mounted in order to imitate sun's apparent motion.

change in the readings. Preferably the same technique is repeated with the lamp at a new, somewhat higher, altitude. The position of the levels was then finally fixed so that the horizontality of the receiving surfaces of the instrument could be reproduced when the pyrheliometer was moved to its position on the roof of the solar energy building at the Massachusetts Institute of Technology.

Some months later, as a preliminary to the recalibration, by the Weather Bureau staff, of the Eppley pyrheliometers in use at the various solar radiation measuring stations in the United States, an Eppley instrument No. 197, carefully calibrated by the Weather Bureau staff using a Smithsonian silver disk as a standard, was set up beside the instrument No. 434 studied above, normal precautions being taken to put instrument No. 197 into horizontal position without resorting to the special technique previously described. Intercalibrated potentiometers of good precision were used to obtain simultaneous readings of these two pyrheliometers throughout one day and part of another. The results, plotted as relative response of the instruments versus solar time, indicated a variation of 4 percent throughout the day (9 a. m.–3 p. m. in February). The trend of the curve indicated the possibility that the second instrument had not been perfectly level. To test this possibility, spirit levels were affixed to the base of the second pyrheliometer and then adjusted until they were level, without moving the instrument. Then, during a clear day, the readings of this second instrument were compared with those of the original pyrheliometer, No. 434, rotating the second instrument 180° every reading and using the levels to insure that the instrument tilt was not changed except for orientation during each half revolution. The results appear in fig. 3 as two curves indicating plainly that instrument No. 197 when in position 1 was tilted slightly toward the East. By taking relative readings at 8:30 a. m. and 3:30 p. m., it is possible, by the use of equations giving the angle of incidence of the sun's rays on a tilted surface,

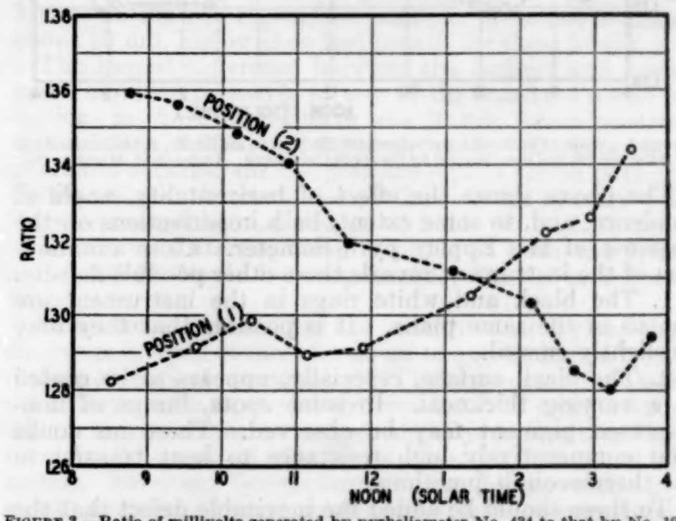


FIGURE 3.—Ratio of millivolts generated by pyrheliometer No. 434 to that by No. 197. No. 197 (position 2) is rotated 180° from the original position 1. Ordinary technique was used in levelling instrument No. 197. Date of test, February 26 and 27, 1941.

to calculate the amount and orientation of the tilt. Such calculations indicated that instrument No. 197 was tilted 0.65° in a direction about 20° South of East, when in position 1. The instrument was then removed to the laboratory, its tilt changed by the amount previously calculated, and the levels readjusted to read level. It was then remounted on the roof for a second test against instrument No. 434. Figure 4 shows the results of this test and indicates the considerable improvement due to releveling. The point coordinates, and departure from the mean of all points, appear in table 1, together with the average percentage departure from the mean, 0.58 percent.

Inasmuch as it was impossible to detect by visual observation the small tilt of the instrument in the original comparison with instrument No. 434, the importance of some such technique of leveling as that described above is obvious. Figs. 3 and 4 indicate that Eppley instruments mounted in the conventional way may be in error as much as 3.6 percent in the region of zenith angle of the sun less than 70°, provided the correct instrument constant (for a level instrument) is known, and assuming that the original tilt of instrument No. 197 may be considered to be the maximum probable.

Figures 2 and 4 lead to the conclusion that any single reading of an Eppley instrument, even though carefully calibrated, may be in error by 1 percent or possibly more, especially for large zenith angles of the sun. The average

of a large number of readings at different times of day and year can, however, be very much more accurate as indicated by the following comparison: The mean response of the first instrument studied, No. 434, was established by the Smithsonian silver disk pyrheliometer as 9.10 millivolts per cal. per sq. cm. per min. in the range of cosine zenith angle 0.6 to 0.95 (zenith angle, 53.1 to 18.2°). The response of the same instrument determined by the transfer of calibration from the carefully standardized pyrheliometer No. 197 is 1.312 × 6.88=9.03 millivolts per cal. per sq. cm. per min., in the same range of zenith angle. These two values were obtained entirely independently and differ by only two-thirds of 1 percent.

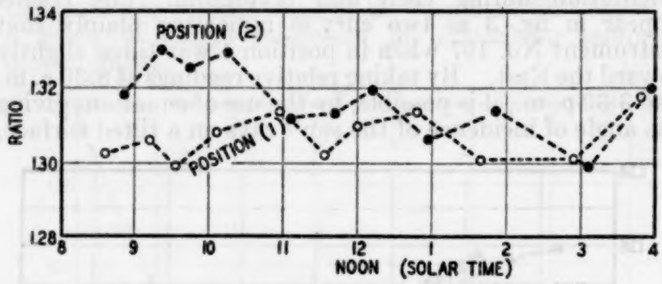


FIGURE 4.—Ratio of millivolts, pyrheliometer No. 434, to millivolts, pyrheliometer No. 197, after No. 197 had been levelled by the special technique. Date of test, March 2, 1941.

The above shows the effect of horizontality, angle of incidence, and, to some extent, bulb imperfections on the response of the Eppley pyrheliometer. Close examination of the instrument reveals these other possible defects:

1. The black and white rings in the instrument are not all in the same plane. It is possible that they may be slightly curved.

2. The black surface, especially, appears to be coated to a varying thickness. In some spots, lumps of non-dispersed pigment may be observed. These no doubt offer comparatively high resistance to heat transfer to the thermocouple junctions.

To these should be added the inevitable defect that the glass bulb does not transmit all the radiation falling on it. The zigzag nature of the curves in figures 3 and 4 suggests that orientation may have a small effect; therefore, the pyrheliometer should be oriented the same in use as during calibration. Otherwise a small additional error may result.

Exhaustive tests of the Eppley pyrheliometer by the manufacturer were afterwards made; and the results forwarded to the Weather Bureau. Insofar as these tests by the manufacturer were similar to those by the writers, the results agree remarkably well, especially considering that each test was conducted independently of the other. The manufacturer also states that he intends to make additional studies of the action of the pyrheliometer and already has taken steps to improve the instrument. Even with its present defects, and the necessity for the calibration curves that are required for accurate data, the Eppley pyrheliometer meets the Weather Bureau specifications, and is the best adapted instrument available for the purposes of the measurements of radiation on a horizontal surface of the type that are conducted by the Weather Bureau.

The total solar and sky radiation pyrheliometers in use at stations have been calibrated by (1) the manufacturer, (2) the Weather Bureau, and (3) the National Bureau of Standards. Some of the calibrations were direct; others were secondary. Previous investigation by the Weather Bureau had shown that the calibration factor varied with season and altitude of the sun, but data based on a constant calibration factor were considered adequate for most purposes. Plans already had been made, and testing apparatus obtained by the Weather Bureau, to check all total solar and sky radiation in operation at stations; therefore, with the growing need for more accurate data, the present project simplified methods of recalibration and brought out the need for obtaining absolute mean horizontality of the pyrheliometers.

Although figures 1 and 2 indicate that for exact pyrheliometry allowance must be made for angle of incidence, such allowance is tedious and perhaps unwarranted in the case of the normal use of Eppley instruments at the various stations. Instead one could construct a plot of average pyrheliometer factor, for the whole day, as a function of time of year, with perhaps a change of calibration factor once a month. A suitable average value of the instrument constant I, cal./sq. cm.×hr. per unit deflection of the electrical instrument, could be obtained as a weighted mean of the values of I throughout the day, weighted in proportion to the intensity of radiation, as follows:

$$I=\frac{(H_S-H_D)_1I_1+(H_S-H_D)_2I_2\;.\;.\;.\;.\;I_{63^\circ}[(H_D)_1+(H_D)_2+\;.\;.\;.\;.]}{(H_S)_1+(H_S)_2\;.\;.\;.\;.}$$

where H_S is the total radiation during individual hours; H_D is diffuse radiation during individual hours; I_1, I_2, ... are average instrument constants during individual hours; I_{63° is the constant for 63° angle of incidence (average value for radiation from a uniform sky).

The most accurate values of I are obtained when monthly average values of H_S and H_D for the different hours of the day are used. Values substantially as good are obtained much more easily if data for a clear day at the middle of the month are used instead. As a result of this study, the Weather Bureau will furnish monthly calibration constants to the solar radiation stations as soon as practicable.

Although the agreement between the two independent calibrations of instrument No. 434 indicates that figure 2 is substantially correct, the pyrheliometric data reported from Cambridge in the MONTHLY WEATHER REVIEW during the past 2 years are somewhat in error, because the data were reported on the basis of the constant calibration factor supplied with the instrument. Anyone using these data and desiring greater accuracy should correct them by figure 2, (or more simply by the average monthly factors which will soon be available), after subtracting diffuse radiation. Corrections for data at other stations will be published shortly after the completion of the recalibration project.

TABLE 1.—*Calibration of M. I. T. pyrheliometer No. 434 by comparison with Weather Bureau pyrheliometer No. 197, Mar. 2, 1941; both instruments were level (as nearly as known); No. 197 was rotated 180° between readings*

[Position 1 is the original orientation; latitude=42°22′]

Mean solar time	Position	Ratio of potentials No. 434–No. 197	Departure from mean
8:37 a. m.	1	1.302	−0.010
8:51 a. m.	2	1.318	+.006
9:12 a. m.	1	1.306	−.006
9:21 a. m.	2	1.330	+.018
9:33 a. m.	1	1.299	−.013
9:44 a. m.	2	1.325	+.013
10:05 a. m.	1	1.308	−.004
10:15 a. m.	2	1.329	+.017
10:56 a. m.	1	1.313	+.001
11:06 a. m.	2	1.312	.000
11:33 a. m.	1	1.302	−.010
11:43 a. m.	2	1.313	+.001
12:00 m.	1	1.309	−.003
12:12 p. m.	2	1.319	+.007
12:48 p. m.	1	1.313	+.001
12:57 p. m.	2	1.306	−.006
1:40 p. m.	1	1.300	−.012
1:50 p. m.	2	1.313	+.001
2:55 a. m.	1	1.301	−.011
3:07 p. m.	2	1.298	−.014
3:42 p. m.	1	1.317	+.005
3:56 p. m.	2	1.320	+.008
Mean ratio		1.312	
Average departure from mean		.0076	
Average percentage departure		.58	

METEOROLOGICAL AND CLIMATOLOGICAL DATA FOR MAY 1941

[Climate and Crop Weather Division, J. B. KINCER in charge]

AEROLOGICAL OBSERVATIONS

By EARL C. THOM

The mean surface temperatures for May were above normal over nearly all of the United States (chart I). At eight widely scattered stations surface temperatures were from 1° to 3° F. below normal for the month while over a considerable part of the upper Mississippi River Valley temperatures were from 6° to 8° F. above normal.

At 1,500 meters above sea level the 5 a. m. resultant winds for the month were from directions to north of normal over most of the country. The resultants were from directions to the south of normal at this level over most of the northwestern and over a considerable area in the Central States while the opposite turning from normal occurred over the rest of the country. At 3,000 meters the morning resultant winds were from directions to the north of normal over the eastern third of the country and over a small area in the Southwest, and were from directions to the south of normal over all other parts of the United States. When the 5 p. m. resultant winds were compared with the corresponding 5 a. m. normals for the 5,000 m. level it was found that the late afternoon resultants were from dirctions to the south of the corresponding morning normals over most of the country. The turning of resultants to the northward during the day at this level occurred over only two stations in the western two-thirds of the country and over six stations to the eastward.

At both the 1,500-m. and 3,000-m. levels the 5 a. m. resultant wind velocities for the month were generally above the corresponding normals while at 5,000 meters the late afternoon resultant velocities were considerably above the corresponding morning normals over all stations except Salt Lake City.

At 1,500 m. the late afternoon resultant winds for the month were from directions to the south of the directions of the corresponding morning winds except in the extreme Northwest and along the Gulf coast where opposite turning took place during the day. The turning of the resultants to the southward during the day was also generally the case at the 3,000-m. level.

The 5 p. m. resultant wind velocities at 1,500 meters were higher than the corresponding morning velocities over the extreme Northwest and over most of the Northeast and extreme East portions of the country, while these velocities in general decreased during the day at this level over the remainder of the country. At 3,000 meters the late afternoon resultant velocities were generally higher than those in the morning, there being only scattered stations where the velocities decreased during the day.

The upper air data discussed above are based on 5 a. m. (E. S. T.) pilot-balloon observations (charts VIII and IX) as well as on observations made at 5 p. m. (table 2 and charts X and XI).

At radiosonde and airplane stations in the United States proper, the highest mean monthly pressure at each of the 20 standard levels from 1,000 to 18,000 meters occurred over the southern third of the United States. At 10,000 meters the highest mean pressure was over Miami. At 9 of the lower levels the highest mean pressure for the country was recorded over Pensacola while at 10 of the 20 standard levels the same highest mean pressure was reported over 2 or more stations. The lowest mean pressure for the month was recorded over Portland, Maine, for the standard levels from 1,000 to 3,000 meters and over Seattle, Wash., for the levels from 5,000 to 13,000 meters while the same minimum was reported by both Seattle, Wash., and Portland, Maine, for the 4,000-m. level and for the levels from 14,000 meters to 18,000 meters, inclusive.

Mean monthly pressures for May were generally higher than those of last month at all levels above the surface. The only exception of interest occurred over northeastern and extreme eastern parts of the country at the 1,000-, 1,500-, and 2,000-m. levels. This increase in mean pressure over that of last month was considerable over the western half of the country especially at the levels from 5,000 to 13,000 meters, inclusive. Over the Rocky Mountain Plateau region, for example, pressures averaged about 10 mb. higher than last month for these levels.

The largest difference between the highest and lowest mean monthly pressures at any of the standard levels for stations in the United States was 20 mb. which occurred at the 7,000-, 8,000-, and 9,000-m. levels. Steep pressure gradients occurred on the pressure charts across both the northwest and the northeast sections of the country with the steepest gradient, a change of 1 mb. for each 50 miles of horizontal distance, being recorded at both the 8,000- and 9,000-m. levels between Seattle, Wash., and Boise, Idaho.

Mean temperatures for the month were higher than they were in April at most levels up to and including 11,000 meters over all of the country. The only exceptions were over Brownsville at the levels from 2,000 to 4,000 meters, where temperatures averaged slightly lower than last month. At most of the levels from 12,000 to 19,000 meters, however, temperatures were higher than last month over the extreme northwestern and extreme northeastern parts of the United States. Over the rest of the country temperatures were lower than last month at these levels, being considerably lower over the Rocky Mountains as shown at Denver where temperatures averaged 5° C. lower than last month for the levels from 13,000 to 17,000 meters.

Comparisons of the May mean temperature charts for 1941 with those for 1940 show that temperatures over the eastern two-thirds of the country were higher than last year at most levels up to 12,000 meters, while they were lower at most of these levels over the western third of the country. Above 12,000 meters the departures were the opposite with most of these upper levels recording mean temperatures higher than last year over the western one-third and lower over the eastern two-thirds of the country.

At 1,000 meters temperatures were above normal over most of the country, being below normal at this level only at St. Louis and in parts of the extreme West. At 3,000 meters temperatures were below normal for the month over most of the northern half of the country and above normal to the southward. At 5,000 meters temperatures were generally below normal west of the Great Divide and in the extreme northeast with temperatures elsewhere in the country at this level above normal.

Mean relative humidities at the 1,000-m. level were below normal for the month over the southeast and over the southern California coastal area and above normal generally over the rest of the country. At the 3,000- and 5,000-m. levels relative humidities were generally above normal, there being only a few scattered exceptions.

The altitude at which the monthly mean temperature of 0° C. occurred, varied over the United States from 2,200 meters over Seattle, Wash., to 4,500 meters over Brownsville, Tex., and Pensacola, Fla. At San Juan this mean temperature of 0° occurred at 4,900 meters while at Swan Island it occurred at 5,000 meters. The level at which freezing conditions occurred during the month was higher than in April, being much higher over the Rocky Mountains where it averaged about 1,200 meters higher than last month.

The lowest temperature for the month in the free air over the United States was −79.0° C. (−110.2° F.) recorded over Miami, Fla., on the 6th at an altitude of 14,600 meters (about 9 miles). A lower temperature, −87.5° C. (−125.5° F.) was, however, recorded at 16,900 meters over Swan Island on the 5th.

Table 3 shows the maximum free air wind velocities and their directions for various sections of the United States during May as determined by pilot balloon observations. The highest wind velocity for the month was 70.8 meters per second (158.3 m. p. h.) observed over Rapid City, S. Dak., on May 7. This wind was blowing from the WNW. at an elevation of 9,990 meters.

The highest wind velocities observed in the month of May during the last 5 years occurred in 1939. In the upper-air layer from the surface to 2,500 meters a wind of 47.7 m. p. s. was reported on May 19, 1939, blowing from the WNW. at an elevation of 1,700 meters over Billings. In the next layer, from 2,500 meters to 5,000 meters, the highest wind during the month in the last 5 years was 58.7 m. p. s. reported on May 21, 1939, from the SSW. at an elevation of 3,080 meters over Ely, Nev., while above 5,000 meters the corresponding maximum for this period was 80.0 m. p. s. from the SSW. on May 8, 1939, at 16,630 meters over Redding, Calif.

TABLE 1.—*Mean free-air barometric pressure in millibars, temperature in degrees centigrade, and relative humidities in percent, obtained by airplanes and radiosondes during May 1941*

Altitude (meters) m. s. l.	Albuquerque, N. Mex. (1,620 m.)				Atlanta, Ga. (300 m.)				Bismarck, N. Dak. (505 m.)				Boise, Idaho (864 m.)				Brownsville, Tex. (6 m.)				Buffalo, N. Y. (221 m.)				Charleston, S. C. (14 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	31	837	16.0	48	31	983	19.0	61	30	953	12.8	71	31	914	12.7	70	31	1,013	22.7	91	31	989	10.9	73	30	1,016	16.8	88
500					31	960	21.4	58									31	957	20.7	84	31	957	13.6	64	30	960	19.4	55
1,000					31	906	18.7	54	30	899	12.9	65	31	899	14.8	63	31	903	19.1	70	31	902	11.2	58	30	906	16.9	46
1,500					31	854	15.5	53	30	846	10.5	64	31	848	12.6	54	31	852	16.9	60	31	849	8.0	58	30	854	13.8	44
2,000	31	800	15.2	46	31	805	11.9	55	30	797	8.0	62	31	798	8.8	54	31	804	14.7	53	31	799	5.0	60	30	804	10.6	45
2,500	31	754	11.9	44	31	758	8.4	58	30	750	4.7	61	31	751	5.0	58	31	757	12.2	49	31	751	1.7	63	30	757	7.6	45
3,000	31	710	8.2	45	31	713	5.1	57	30	705	1.6	61	31	706	1.8	61	31	713	9.4	45	31	705	−1.2	65	30	712	4.7	42
4,000	30	628	0.1	50	30	630	0.1	49	30	622	−4.4	60	30	623	−5.0	65	31	631	3.4	43	30	622	−6.3	62	30	629	−0.9	33
5,000	30	553	−7.7	54	30	556	−5.6	45	30	547	−11.0	59	30	548	−12.0	64	31	557	−3.0	41	29	546	−11.9	54	30	555	−7.0	28
6,000	30	486	−14.6	48	30	488	−12.2	42	30	480	−17.7	51	29	480	−18.9	58	31	491	−9.7	36	29	479	−18.6	50	30	487	−13.2	28
7,000	30	425	−21.8	44	29	428	−19.4	41	30	419	−24.8	47	26	419	−25.9	53	31	430	−16.9	33	29	418	−26.0	47	30	426	−20.1	25
8,000	30	370	−29.1	42	29	373	−26.5	39	29	364	−32.4	47	26	364	−33.4	52	31	376	−24.3	31	29	363	−33.3	44	30	371	−27.8	24
9,000	30	321	−36.5	41	29	323	−34.2	38	29	315	−40.0	45	24	315	−40.9		31	326	−31.5	30	29	314	−40.5		30	322	−35.9	24
10,000	30	278	−43.7		29	280	−42.0		29	272	−47.1		22	272	−48.3		31	283	−38.7	30	27	271	−47.2		30	279	−43.3	
11,000	30	239	−50.5		29	241	−49.3		28	233	−52.8		21	233	−53.6		30	244	−45.9		27	232	−51.3		30	240	−50.6	
12,000	29	204	−56.0		29	206	−55.8		28	200	−55.4		21	199	−55.0		30	210	−52.9		27	199	−54.2		29	205	−56.7	
13,000	29	174	−58.2		29	176	−59.8		28	171	−55.2		21	170	−54.0		28	179	−59.1		26	170	−56.4		28	175	−60.4	
14,000	28	149	−60.0		28	150	−62.2		28	146	−54.3		19	146	−53.6		27	153	−62.9		26	145	−56.4		28	149	−62.4	
15,000	28	127	−60.0		27	128	−62.8		28	125	−55.4		18	124	−54.3		27	129	−65.3		26	124	−56.1		28	126	−64.7	
16,000	28	108	−61.3		26	108	−63.3		28	107	−56.5		17	106	−55.4		26	110	−67.4		25	106	−57.1		27	107	−65.1	
17,000	27	92	−62.6		25	92	−63.0		26	91	−56.5		15	91	−56.0		25	93	−68.8		23	90	−57.4		26	91	−64.6	
18,000	25	78	−62.3		19	78	−61.6		17	78	−56.4		13	77	−56.2		20	78	−67.9		19	76	−56.5		21	77	−63.3	
19,000	20	67	−60.8		12	66	−59.4		8	67	−56.4		5	66	−56.2		13	67	−65.6		11	65	−55.6		16	66	−61.2	
20,000	8	56	−59.4																		6	55	−55.0		7	56	−58.5	

Altitude (meters) m. s. l.	Coco Solo, C. Z.[1, 2] (15 m.)				Denver, Colo. (1,616 m.)				El Paso, Tex. (1,193 m.)				Ely, Nev. (1,908 m.)				Great Falls, Mont. (1,128 m.)				Juneau, Alaska (49 m.)				Ketchikan, Alaska (26 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	23	1,011	26.9	88	28	836	12.0	68	31	880	20.7	45	31	808	8.4	61	31	885	11.3	58	29	1,005	10.5	66	31	1,010	9.8	75
500	23	956	24.6	90																	29	952	7.2	70	31	954	7.2	74
1,000	23	904	21.9	83																	29	895	3.4	74	31	897	3.6	76
1,500	23	853	19.1	77					31	849	20.4	42					31	846	11.2	57	29	841	−0.2	79	31	843	−0.1	78
2,000	23	804	16.7	67	28	799	11.9	61	31	801	17.0	41	31	800	10.1	56	30	796	7.7	56	29	790	−3.8	83	31	792	−3.5	75
2,500	23	758	14.3	56	28	752	8.8	59	31	755	13.3	42	31	753	8.2	50	30	749	4.0	57	29	741	−7.2	83	31	742	−6.7	72
3,000	23	714	11.5	51	27	708	5.4	58	31	711	9.2	43	31	708	4.4	50	30	704	0.2	59	28	695	−10.2	79	31	696	−9.9	67
4,000	10	633	4.7	55	27	626	−2.0	60	31	629	1.5	46	31	626	−3.3	56	30	621	−6.7	62	24	609	−16.4	70	31	610	−16.5	61
5,000					27	551	−9.7	60	31	555	−6.0	49	30	551	−10.5	59	30	546	−13.6	61	23	533	−23.2	66	31	534	−23.0	59
6,000					27	483	−16.9	60	30	488	−13.2	50	30	483	−17.1	54	30	477	−20.5	61	21	464	−30.0	64	31	465	−29.8	56
7,000					27	423	−23.9	56	30	427	−20.4	47	30	422	−24.7	51	30	416	−27.5	59	20	402	−37.1	63	30	403	−36.6	55
8,000					26	368	−31.2	54	30	372	−27.7	45	30	366	−31.9	48	30	362	−34.7	58	20	347	−43.9		26	348	−43.2	
9,000					26	319	−38.8	52	30	323	−35.4	44	28	317	−39.5	47	29	313	−41.6		16	298	−48.5		24	299	−48.2	
10,000					26	275	−46.4		29	279	−43.1		27	274	−46.9		29	270	−48.1		16	256	−50.7		23	257	−49.9	
11,000					25	236	−52.9		29	240	−49.7		26	235	−52.0		27	232	−53.0		13	220	−47.3		23	221	−50.1	
12,000					24	202	−58.1		29	206	−55.5		26	201	−54.4		23	198	−54.4		13	189	−45.8		21	189	−48.8	
13,000					23	173	−59.5		29	176	−59.6		25	172	−55.6		25	169	−53.5		12	162	−45.4		21	162	−48.4	
14,000					23	147	−59.1		28	150	−61.5		23	147	−56.3		24	145	−53.6		10	140	−45.5		16	139	−48.6	
15,000					21	126	−60.3		28	127	−62.2		22	125	−57.3		24	124	−54.1		10	120	−46.0		14	119	−49.0	
16,000					19	107	−61.1		27	108	−63.7		22	107	−58.5		21	105	−55.6		8	104	−46.2		11	102	−49.2	
17,000					17	91	−60.7		24	92	−65.2		19	91	−59.3		15	90	−55.9		8	89	−46.6		6	87	−49.0	
18,000					11	78	−60.0		21	78	−64.4		14	77	−59.5		12	76	−55.7		7	77	−46.9					
19,000					7	67	−59.3		12	66	−62.4		7	66	−58.7		8	65	−54.4		5	66	−47.2					

Footnotes at end of table.

TABLE 1.—*Mean free-air barometric pressure in millibars, temperature in degrees centigrade, and relative humidities in percent, obtained by airplanes and radiosondes during May 1941*—Continued

Altitude (meters) m. s. l.	Stations with elevations in meters above sea level																											
	Lakehurst, N. J.[1] (39 m.)				Medford, Oreg. (401 m.)				Miami, Fla. (4 m.)				Nashville, Tenn. (180 m.)				Nome, Alaska (14 m.)				Norfolk, Va.[1,2] (10 m.)				Oakland, Calif. (20 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	31	1,010	11.1	81	31	968	13.7	68	31	1,016	20.6	84	31	996	18.2	60	30	1,007	4.2	70	29	1,017	16.5	78	31	1,016	15.5	74
500	31	957	14.1	67	31	956	14.0	68	31	960	19.7	82	31	960	19.4	59	30	948	0.9	71	29	960	18.1	56	30	958	12.8	76
1,000	31	902	11.4	63	31	901	11.7	68	31	905	16.5	82	31	906	16.3	58	30	891	−1.9	71	29	905	15.9	49	30	903	12.3	62
1,500	31	849	8.1	64	31	848	8.4	72	31	854	14.3	68	31	854	13.1	59	30	836	−4.3	68	29	853	12.8	52	30	850	10.5	59
2,000	31	799	4.7	66	31	798	4.9	76	31	804	12.7	51	31	804	9.8	59	30	785	−7.4	67	29	803	10.0	53	30	800	8.3	56
2,500	31	751	1.6	65	31	750	1.9	77	31	758	10.4	44	31	757	6.6	61	30	736	−10.4	65	28	756	6.5	55	30	753	5.7	51
3,000	31	706	−1.1	63	31	705	−1.0	73	31	713	7.9	39	31	712	3.4	60	30	689	−13.3	62	28	711	3.2	57	31	708	3.1	48
4,000	31	621	−6.6	57	31	621	−6.9	63	31	631	2.7	33	31	629	−1.9	51	30	603	−19.2	59	28	627	−2.6	54	31	625	−3.1	45
5,000	31	546	−12.1	50	31	546	−12.6	58	31	557	−3.2	30	31	554	−7.8	47	30	527	−25.6	58	23	553	−8.8	44	31	550	−9.5	43
6,000	31	478	−18.5	46	31	478	−19.4	58	31	490	−9.7	29	30	486	−14.5	46	29	458	−32.7	57					31	482	−16.5	43
7,000	31	417	−25.6	47	31	417	−25.9	57	31	430	−16.8	29	28	426	−21.3	44	29	396	−39.6	55					31	422	−23.7	41
8,000	31	363	−33.0	53	30	362	−33.4	55	30	376	−23.9	28	28	371	−28.3	43	29	342	−46.0						31	366	−31.1	39
9,000	31	314	−40.3		30	313	−40.9		29	327	−31.0	28	27	322	−35.6	42	29	293	−50.7						31	317	−38.5	39
10,000	31	271	−46.6		30	270	−47.3		29	284	−38.3	28	27	278	−43.2		28	252	−50.1						31	274	−45.7	
11,000	31	233	−51.3		29	232	−52.1		29	245	−45.5		27	239	−50.5		28	217	−46.8						31	235	−51.8	
12,000	30	190	−54.8		29	198	−54.5		29	210	−52.9		27	205	−56.5		28	186	−45.1						31	201	−55.7	
13,000	30	170	−56.8		27	170	−53.9		28	179	−60.1		26	175	−61.1		27	160	−44.8						31	172	−56.3	
14,000	29	146	−58.2		26	145	−54.0		27	152	−65.4		25	148	−62.3		26	138	−44.7						31	146	−56.9	
15,000	27	124	−58.5		25	124	−54.5		27	129	−68.6		25	126	−63.2		22	119	−44.9						30	125	−57.7	
16,000	23	106	−58.3		22	107	−55.7		26	110	−70.3		23	107	−63.5		21	102	−45.1						25	107	−59.2	
17,000	19	90	−58.0		20	91	−56.0		25	93	−69.6		22	91	−64.0		21	88	−45.2						22	91	−59.6	
18,000	7	76	−57.1		16	78	−55.8		20	78	−66.5		20	77	−63.0		16	76	−45.3						14	77	−58.2	
19,000					7	67	−55.4		13	66	−63.1		18	65	−61.6		11	65	−45.6						10	66	−57.5	
20,000									5	56	−60.1		12	55	−60.0		7	56	−45.8									
21,000													5	47	−58.5													

Altitude (meters) m. s. l.	Stations with elevations in meters above sea level																											
	Oklahoma City, Okla. (391 m.)				Omaha, Nebr. (301 m.)				Pearl Harbor, T. H. (7 m.)[1,2]				Pensacola, Fla. (24 m.)				Phoenix, Ariz. (339 m.)				Portland, Maine (19 m.)				St. Louis, Mo. (171 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	31	969	18.9	85	31	979	17.8	71	31	1,015	21.1	78	30	1,016	23.5	73	31	970	20.6	51	27	1,009	8.9	86	31	996	18.0	73
500	31	957	19.4	79	31	956	17.5	68	31	959	19.5	77	30	961	21.6	66	31	953	25.4	42	27	953	12.6	69	31	959	17.2	69
1,000	31	903	18.2	70	31	902	15.0	65	31	905	16.4	82	30	908	19.1	61	31	900	22.8	36	27	898	9.7	66	30	904	14.1	69
1,500	31	852	15.6	69	31	850	12.3	65	31	853	13.7	79	30	856	16.1	58	31	849	19.0	34	27	844	6.4	66	30	852	11.1	70
2,000	31	803	12.9	64	31	800	9.3	64	31	804	12.1	61	30	807	12.9	57	31	800	14.8	35	27	794	3.0	69	30	802	8.9	67
2,500	31	756	10.0	59	31	753	6.1	63	31	757	10.9	46	30	760	10.1	53	31	754	10.9	36	27	746	−0.7	72	30	754	6.1	64
3,000	31	712	6.8	59	31	709	2.9	63	31	713	9.5	35	30	715	7.8	47	31	710	7.0	39	27	701	−2.5	72	30	710	3.2	63
4,000	31	630	0.4	58	31	626	−3.3	54	31	632	6.0	23	29	633	2.9	37	30	628	0.3	43	25	617	−8.5	66	29	626	−2.6	57
5,000	31	555	−5.7	52	31	550	−9.4	49					26	559	−2.7	36	30	554	−6.3	44	24	542	−14.4	60	29	552	−8.6	51
6,000	31	488	−12.6	47	31	483	−16.1	44					20	492	−9.0	37	30	487	−13.4	42	23	474	−21.3	55	29	484	−15.2	45
7,000	31	427	−19.5	43	27	423	−22.9	42					20	432	−16.0	40	28	426	−21.1	41	22	413	−28.9	55	29	423	−22.1	39
8,000	30	372	−26.7	41	27	368	−30.1	40					18	376	−23.5	43	28	371	−28.8	40	21	358	−36.0	53	27	369	−29.2	37
9,000	30	323	−34.1	40	27	318	−37.5	37					17	327	−31.0	48	27	322	−36.3	39	20	309	−43.0		26	319	−36.5	36
10,000	30	280	−42.1		26	275	−44.7						17	283	−38.4		26	279	−43.4		19	266	−48.2		23	276	−43.9	
11,000	28	241	−49.7		26	236	−51.5						14	245	−45.5		26	240	−49.4		18	229	−51.1		21	237	−50.6	
12,000	27	206	−56.6		25	202	−57.1						14	210	−52.1		26	206	−54.1		17	196	−53.1		21	203	−56.7	
13,000	24	176	−61.5		25	172	−60.1						12	180	−57.9		25	175	−57.1		17	168	−54.8		20	173	−61.1	
14,000	24	150	−62.0		22	147	−59.3						8	154	−62.7		25	150	−58.2		15	143	−55.1		19	147	−62.4	
15,000	24	127	−62.2		22	125	−59.0										25	128	−59.2		13	122	−55.1		18	125	−62.1	
16,000	24	108	−63.1		22	106	−59.3										25	100	−60.5		11	105	−56.1		17	107	−61.5	
17,000	20	92	−63.2		22	91	−59.2										24	93	−61.8		10	89	−56.8		16	91	−61.4	
18,000	13	78	−61.7		18	77	−59.5										21	79	−61.9		9	76	−56.5		15	77	−60.9	
19,000	8	66	−60.5		15	66	−58.4										19	68	−60.3						13	66	−60.0	
20,000					10	56	−57.6										10	57	−58.6						9	55	−58.7	
21,000																	5	49	−56.6						5	47	−57.2	

Footnotes at end of table.

TABLE 1.—*Mean free-air barometric pressure in millibars, temperature in degrees centigrade, and relative humidities in percent, obtained by airplanes and radiosondes during May 1941*—Continued

Altitude (meters), m. s. l.	Stations with elevations in meters above sea level																							
	St. Paul, Minn. (225 m.)				San Diego, Calif.[1] (19 m.)				San Antonio, Tex. (174 m.)				San Juan, P. R. (15 m.)				St. Thomas, V. I.[1 2] (8 m.)				S. S. Marie, Mich. (221 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	31	987	15.5	74	29	1,011	18.2	79	31	994	21.3	91	30	1,013	24.9	87	28	1,015	27.6	75	31	989	8.4	79
500	31	956	15.3	70	29	956	16.4	73	31	958	20.5	89	30	959	23.3	88	28	960	23.5	93	31	957	10.4	71
1,000	31	901	13.1	67	29	901	16.6	58	31	904	18.8	80	30	905	20.3	83	28	907	20.2	84	31	901	9.8	64
1,500	31	848	10.4	67	29	850	15.0	46	31	853	16.1	75	30	854	17.5	79	28	856	17.6	77	31	848	7.3	63
2,000	31	799	7.8	65	29	800	13.3	38	31	804	14.1	67	30	805	15.1	68	28	807	15.5	68	31	798	4.4	62
2,500	31	752	5.2	63	29	754	10.4	34	31	757	11.9	57	30	759	12.7	65	27	760	13.3	59	31	750	1.3	63
3,000	31	707	2.3	65	29	709	7.1	33	31	713	9.2	49	30	715	10.0	59	27	717	10.9	52	31	704	−1.6	66
4,000	31	624	−3.8	65	29	628	0.8	34	31	631	3.0	45	30	634	4.7	50	27	635	5.7	52	31	620	−7.1	64
5,000	31	549	−9.7	54	29	553	−6.4	35	31	558	−3.4	40	30	560	−0.6	45					31	545	−12.6	56
6,000	31	481	−16.4	49	29	486	−12.7	34	31	490	−10.4	37	30	493	−6.2	42					31	477	−19.0	51
7,000	31	420	−23.8	47	29	426	−20.1	34	31	430	−17.2	36	30	434	−12.6	41					30	416	−26.0	50
8,000	30	366	−30.9	45	25	371	−27.8		31	375	−24.3	35	27	380	−19.6	41					29	362	−33.3	49
9,000	30	317	−38.0	44	24	322	−35.1		31	326	−31.8	35	26	331	−26.6	40					28	313	−40.6	
10,000	29	274	−44.9		22	278	−42.1		30	283	−39.6	35	24	288	−34.0	39					26	270	−47.1	
11,000	29	235	−51.3		22	240	−48.8		28	244	−47.2		21	249	−42.0						25	232	−52.0	
12,000	28	202	−56.2		22	206	−55.1		26	209	−53.7		19	214	−50.0						23	198	−55.1	
13,000	25	172	−58.0		20	176	−58.9		25	178	−58.6		17	183	−58.1						22	169	−55.7	
14,000	23	146	−56.7		16	150	−61.5		25	152	−61.7		17	156	−65.7						21	145	−55.0	
15,000	21	125	−56.7		14	127	−63.0		24	129	−63.8		17	132	−72.9						20	124	−55.2	
16,000	18	107	−57.3		11	108	−65.1		23	110	−65.2		16	111	−77.6						16	106	−55.8	
17,000	16	91	−56.7		8	92	−64.5		19	93	−66.2		15	93	−77.6						8	91	−56.2	
18,000	9	77	−56.1						15	79	−65.0		13	78	−74.5						6	78	−56.1	
19,000	8	66	−55.4						12	67	−62.9		11	66	−68.9									
20,000	7	56	−55.0										8	56	−63.6									
21,000	5	48	−54.2										5	46	−59.2									

Altitude (meters) m. s. l.	Stations with elevations in meters above sea level																Late report April 1941			
	Seattle, Wash.[1] (27 m.)				Spokane, Wash. (598 m.)				Swan Island, W. I. (10 m.)				Washington, D. C. (5 m.)				Swan Island, West Indies (10 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	30	1,012	12.8	76	31	943	11.7	73	30	1,010	26.4	84	29	1,016	16.1	65	30	1,011	26.3	81
500	30	956	10.4	77					30	956	23.4	88	29	958	16.6	57	30	956	22.6	85
1,000	30	901	7.4	80	31	[illegible]	11.3	66	30	903	20.4	84	29	903	13.9	53	30	903	20.3	82
1,500	30	848	4.1	84	31	846	8.2	63	30	852	17.9	78	29	851	10.6	53	30	852	18.1	68
2,000	30	796	0.8	84	31	796	4.7	65	30	803	15.5	71	29	801	6.8	55	30	803	15.5	59
2,500	30	748	−2.2	80	31	748	1.0	68	30	757	13.2	67	29	754	3.8	55	30	757	12.7	52
3,000	30	702	−4.8	74	31	703	−2.4	69	30	713	10.7	64	29	708	0.7	55	30	713	10.7	44
4,000	30	617	−10.4	67	30	619	−8.8	67	29	632	5.6	68	29	624	−5.2	57	30	632	5.5	35
5,000	30	541	−17.3	66	30	543	−15.3	63	28	559	0.1	67	29	549	−10.7	51	30	559	−0.4	33
6,000	30	473	−24.3	70	29	475	−22.0	59	28	493	−5.9	63	29	481	−17.0	46	30	492	−6.0	33
7,000	30	412	−31.4	73	26	414	−28.6	57	26	433	−12.0	58	29	421	−24.1	44	30	433	−12.8	34
8,000	30	356	−38.0	70	26	359	−36.0	54	25	380	−18.7	56	28	365	−31.4	42	30	379	−19.7	34
9,000	29	307	−44.6		23	310	−42.9		24	330	−26.0	55	28	317	−38.5	39	30	330	−26.6	34
10,000	29	265	−50.0		23	267	−48.8		23	288	−33.6	53	28	274	−44.9		30	287	−34.1	34
11,000	29	227	−52.7		22	230	−52.8		21	249	−42.0		28	235	−50.2		30	248	−41.7	
12,000	27	195	−52.7		20	196	−53.3		21	214	−50.0		27	202	−54.4		29	214	−49.5	
13,000	26	167	−52.6		20	168	−51.3		21	183	−58.6		27	172	−57.3		29	183	−57.4	
14,000	25	143	−52.8		18	144	−51.1		21	156	−67.0		27	147	−58.2		29	156	−64.9	
15,000	23	122	−53.6		13	123	−51.2		20	132	−74.4		24	125	−58.3		29	132	−72.3	
16,000	22	105	−54.7		10	106	−52.2		19	110	−79.7		18	106	−58.4		29	111	−77.6	
17,000	21	89	−55.6		6	91	−52.4		19	92	−81.4		13	91	−58.2		27	93	−79.6	
18,000	17	76	−55.6						13	77	−76.5		8	77	−57.3		24	78	−76.5	
19,000	12	64	−55.2						10	65	−70.8		5	65	−56.5		19	66	−70.4	
20,000	5	54	−54.7						5	55	−65.4						13	55	−64.4	
21,000																	9	47	−59.3	
22,000																	5	40	−56.2	

[1] U. S. Navy.
[2] Airplane observations.

NOTE.—All observations taken at 12:30 a. m. 75th meridian time, except at Lakehurst, N. J., where they are taken near 5 a. m. E. S. T., at Norfolk, Va., where they are taken at about 6 a. m. and at Pearl Harbor, T. H., after sunrise.

None of the means included in this table are based on less than 15 surface or 5 standard level observations.

Number of observations refers to pressure only as temperature and humidity data are missing for some observations at certain levels; also, the humidity data are not used in daily observations when the temperature is below −40.0° C.

TABLE 2.—*Free-air resultant winds based on pilot balloon observations made near 5 p. m. (75th meridian time) during May 1941. Directions given in degrees from North (N=360°, E=90°, S=180°, W=270°)—velocities in meters per second*

Altitude (meters) m. s. l.	Abilene, Tex. (537 m.)			Albuquerque, N. Mex. (1,630 m.)			Atlanta, Ga. (299 m.)			Billings, Mont. (1,095 m.)			Bismarck, N. Dak. (512 m.)			Boise, Idaho (866 m.)			Brownsville, Tex. (7 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	30	155	4.2	31	200	1.8	31	252	2.0	30	207	1.1	30	235	1.4	30	307	2.4	30	127	5.4
500							31	270	2.3										30	124	6.2
1,000	30	158	5.3				31	272	2.1	30	243	2.1	28	239	25.3	30	316	2.2	24	127	3.3
1,500	29	175	5.8				31	273	2.6	30	234	1.8	28	245	3.4	30	296	2.2	22	131	2.0
2,000	28	190	6.2	31	177	2.6	29	283	3.6	29	245	3.0	24	238	5.4	30	258	2.7	18	145	0.5
2,500	25	202	5.1	31	227	3.3	28	299	4.3	28	252	4.6	20	232	7.3	28	244	4.3	17	74	0.7
3,000	24	216	4.8	30	240	4.7	26	303	4.7	24	260	9.4	20	250	7.4	27	253	5.4	15	16	2.1
4,000	21	246	3.9	29	246	6.9	24	303	6.3	20	260	10.0	15	271	9.0	22	247	6.3	13	16	2.7
5,000	19	259	5.4	25	260	10.6	22	303	8.1	18	264	10.5	13	278	10.5	18	267	7.0	10	301	3.5
6,000	17	281	6.1	23	256	9.4	22	307	10.5	14	267	11.7	12	282	13.0	13	245	10.8			
8,000	16	270	8.5	15	268	14.7	18	295	11.1												
10,000	14	262	11.5	10	297	16.8	15	303	15.5												
12,000	10	258	16.7				10	298	15.7												

Altitude (meters) m. s. l.	Buffalo, N. Y. (220 m.)			Burlington, Vt. (132 m.)			Charleston, S. C. (18 m.)			Chicago, Ill. (192 m.)			Cincinnati, Ohio (152 m.)			Denver, Colo. (1,627 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	31	256	4.1	31	343	2.1	30	170	2.8	30	230	1.0	31	262	1.9	29	134	1.3
500	31	261	5.8	31	338	4.0	30	198	3.4	30	247	1.3	31	265	3.7			
1,000	30	269	6.1	31	323	5.3	30	251	2.2	28	249	4.4	31	258	3.9			
1,500	30	282	6.7	29	313	7.0	30	296	3.3	27	249	6.2	30	263	5.0			
2,000	26	296	7.6	26	312	7.6	30	296	4.2	22	249	5.8	29	271	7.0	29	132	1.8
2,500	24	300	8.7	21	314	8.6	30	297	5.5	21	268	5.8	27	276	7.6	28	183	1.4
3,000	19	304	9.6	18	322	9.4	30	297	5.7	19	284	6.2	23	289	8.7	27	218	2.6
4,000	13	327	10.9	11	320	8.6	28	300	7.4	18	299	7.8	17	295	9.2	24	245	6.8
5,000	10	332	13.9				25	299	8.6	14	306	9.0	13	294	9.6	20	261	10.2
6,000	10	336	16.1				23	297	9.7	13	311	9.8				18	254	8.2
8,000							15	298	7.6	10	325	12.6				11	243	15.3
10,000							13	309	12.2									
12,000																		

Altitude (meters) m. s. l.	El Paso, Tex. (1,196 m.)			Ely, Nev. (1,910 m.)			Grand Junction, Colo. (1,413 m.)			Greensboro, N. C. (271 m.)			Havre, Mont. (767 m.)			Jacksonville, Fla. (14 m.)			Las Vegas, Nev. (570 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	31	246	2.3	31	240	2.2	31	254	1.6	29	268	1.8	29	279	1.7	31	95	3.0	31	212	2.5
500										29	269	3.9				31	116	2.1			
1,000										29	270	3.8	29	272	2.1	30	173	0.9	31	218	3.3
1,500	31	239	2.3				31	255	1.7	29	281	5.5	29	257	2.3	29	279	1.7	31	216	2.9
2,000	31	256	2.4	31	241	2.4	31	242	1.9	28	299	7.2	28	252	4.5	27	296	1.6	31	222	2.4
2,500	31	252	3.4	31	251	2.6	31	232	2.0	28	300	7.9	27	246	5.5	26	322	2.4	31	235	3.4
3,000	30	251	4.7	31	230	3.3	31	236	3.5	25	304	9.1	26	242	7.1	26	321	3.3	31	239	4.7
4,000	28	253	7.4	29	226	4.5	30	223	4.1	22	313	10.5	14	243	8.2	25	296	4.0	28	275	6.1
5,000	23	255	10.3	24	234	6.6	23	240	7.5	20	313	12.7	11	258	11.8	24	302	6.2	27	267	7.0
6,000	21	263	10.5	22	259	6.4	16	265	8.4	20	313	12.3	11	255	13.8	23	292	7.2	27	273	9.0
8,000	11	271	14.3	14	248	10.0				15	320	16.0				18	276	7.2	23	281	11.5
10,000				10	254	12.6				14	322	18.1				14	302	9.7	17	262	15.8
12,000																12	287	15.6	11	265	18.4

Altitude (meters) m. s. l.	Little Rock, Ark. (79 m.)			Medford, Oreg. (410 m.)			Miami, Fla. (10 m.)			Minneapolis, Minn. (265 m.)			Mobile, Ala. (9 m.)			Nashville, Tenn. (194 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	29	180	1.7	30	286	1.2	31	85	5.0	31	187	2.6	31	169	3.5	31	291	1.5
500	29	184	2.8	30	286	1.6	31	87	5.2	31	190	3.0	31	174	3.3	31	280	2.1
1,000	29	187	3.0	30	253	0.9	28	64	4.6	28	212	4.3	31	147	1.7	31	274	2.6
1,500	29	209	3.5	29	214	2.0	26	48	3.0	26	224	5.6	31	105	1.9	31	268	2.7
2,000	27	213	4.9	27	199	2.8	23	36	2.3	24	236	7.6	29	85	1.8	30	267	4.0
2,500	26	230	5.0	24	207	3.7	22	16	1.8	23	247	8.4	26	45	2.1	28	279	5.2
3,000	24	230	3.8	22	227	4.1	22	353	2.3	20	257	8.6	26	13	1.5	24	272	5.4
4,000	18	249	3.7	19	238	6.4	20	295	3.6	14	266	10.8	21	307	2.3	16	288	6.0
5,000	15	282	5.9	17	242	6.8	21	285	5.1				16	291	4.9	13	289	7.1
6,000	14	271	7.8	15	259	8.6	21	284	6.1				14	292	3.2			
8,000				10	286	12.4	16	280	12.7									
10,000							10	279	19.3									
12,000																		

Altitude (meters) m. s. l.	New York, N. Y. (15 m.)			Oakland, Calif. (8 m.)			Oklahoma City, Okla. (402 m.)			Omaha, Nebr. (306 m.)			Phoenix, Ariz. (338 m.)			Rapid City, S. Dak. (982 m.)			St. Louis, Mo. (181 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	31	268	2.1	30	262	4.6	30	160	4.7	31	195	2.4	31	244	1.7	31	210	1.4	31	200	1.9
500	31	288	3.9	29	272	3.4	30	164	5.0	31	188	3.6	31	247	2.5				31	226	2.5
1,000	29	301	6.0	28	258	2.9	30	170	5.9	31	199	3.5	31	259	3.0	31	209	1.4	31	222	3.9
1,500	29	304	7.7	26	245	2.5	29	187	6.3	31	208	4.6	30	250	2.6	31	197	2.5	28	241	4.5
2,000	26	305	9.7	25	248	2.1	27	201	6.2	28	225	4.3	29	245	2.9	31	208	2.6	27	248	5.5
2,500	23	316	9.6	25	271	2.7	25	220	5.2	23	245	6.1	29	236	4.4	31	239	3.6	25	246	6.6
3,000	18	317	10.9	25	283	4.5	24	235	4.8	20	261	7.3	29	241	5.8	30	245	6.7	24	255	6.6
4,000				23	290	6.0	20	244	6.0	18	283	8.1	29	254	7.4	24	256	9.0	22	267	9.3
5,000				22	291	8.8	17	255	6.7	15	289	9.8	28	259	8.8	19	267	9.9	19	264	8.4
6,000				21	288	9.1	13	273	9.8	14	289	12.4	27	264	10.7	17	262	12.4	17	272	8.6
8,000				17	280	10.5				10	286	17.8	23	262	17.4	13	261	15.4	10	286	14.0
10,000				13	273	10.5							12	275	18.9	12	272	21.4			
12,000				10	273	10.0										10	257	18.2			

Altitude (meters) m. s. l.	San Antonio, Tex. (180 m.)			San Diego, Calif. (15 m.)			Sault St. Marie, Mich. (230 m.)			Seattle, Wash. (14 m.)			Spokane, Wash. (603 m.)			Washington, D. C. (10 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	31	130	3.8	29	277	3.5	28	288	3.8	30	240	3.0	30	224	3.4	31	292	1.7
500	31	131	5.2	29	289	3.0	28	292	4.7	30	218	2.9				31	287	4.2
1,000	30	139	4.5	28	288	2.1	27	290	4.4	27	213	3.9	30	229	5.1	31	281	4.6
1,500	25	150	3.6	27	298	2.0	27	281	4.3	26	208	3.5	28	227	5.1	30	285	6.4
2,000	20	147	2.2	27	285	2.1	24	299	5.2	22	202	2.9	23	222	4.7	27	296	7.7
2,500	19	220	0.7	24	261	3.4	22	311	7.6	19	205	3.9	20	233	5.6	26	298	10.2
3,000	16	280	2.4	24	353	3.7	18	323	9.1	15	215	4.5	16	254	6.0	23	310	11.8
4,000	11	301	6.3	20	266	6.7	16	328	10.1	11	245	7.8	10	258	10.5	19	314	13.5
5,000	11	308	6.4	16	259	11.2	12	331	10.9	10	242	12.9				17	315	14.0
6,000							11	350	13.5	10	240	14.6				15	315	14.4
8,000																		
10,000																		
12,000																		

TABLE 3.—*Maximum free-air wind velocities (m. p. s.), for different sections of the United States based on pilot balloon observations during May 1941*

Section	Surface to 2,500 meters (m. s. l.)					Between 2,500 and 5,000 meters (m. s. l.)					Above 5,000 meters (m. s. l.)				
	Maximum velocity	Direction	Altitude (m) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m) m. s. l.	Date	Station
Northeast [1]	42.0	NW	2,000	24	Harrisburg, Pa.	44.0	NW	5,000	26	Caribou, Maine	64.2	NNE	10,880	20	Portland, Maine.
East-Central [2]	32.9	SSW	420	21	Norfolk, Va.	47.2	WNW	4,890	9	Raleigh, N. C.	46.0	N	12,940	18	Louisville, Ky.
Southeast [3]	27.2	E	620	26	Miami, Fla.	42.5	NNW	5,000	13	Montgomery, Ala.	65.5	W	13,080	11	Tampa, Fla.
North-Central [4]	37.4	S	1,780	23	Rapid City, S. Dak.	35.4	WNW	2,820	8	Huron, S. Dak.	70.8	WNW	9,990	7	Rapid City, S. Dak.
Central [5]	42.1	W	2,500	8	Des Moines, Iowa	56.0	WNW	3,090	8	Des Moines, Iowa	64.0	WNW	11,290	7	Wichita, Kans.
South-Central [6]	42.8	S	1,900	19	Amarillo, Tex.	49.4	S	2,990	19	Amarillo, Tex.	38.0	NW	5,770	12	Jackson, Miss.
Northwest [7]	41.4	W	2,500	5	Pendleton, Oreg.	41.7	W	2,520	5	Pendleton, Oreg.	56.5	WNW	6,850	7	Billings, Mont.
West-Central [8]	37.5	WNW	2,290	6	Cheyenne, Wyo.	50.6	NNW	4,600	18	Sacramento, Calif.	66.5	NNW	10,930	18	Redding, Calif.
Southwest [9]	38.7	ESE	1,850	21	Albuquerque, N. Mex.	42.0	NNW	4,170	4	Sandberg, Calif.	60.3	N	9,020	19	Las Vegas, Nev.

[1] Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and northern Ohio.
[2] Delaware, Maryland, Virginia, West Virginia, southern Ohio, Kentucky, eastern Tennessee, and North Carolina.
[3] South Carolina, Georgia, Florida, and Alabama.
[4] Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota.
[5] Indiana, Illinois, Iowa, Nebraska, Kansas, and Missouri.
[6] Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except extreme west Texas), and western Tennessee.
[7] Montana, Idaho, Washington, and Oregon.
[8] Wyoming, Colorado, Utah, northern Nevada, and northern California.
[9] Southern California, southern Nevada, Arizona, New Mexico, and extreme west Texas.

WEATHER ON THE NORTH ATLANTIC OCEAN

By H. C. HUNTER

Atmospheric pressure.—The average pressure during May 1941, over those portions of the North Atlantic Ocean which are adequately covered by available reports was not far from normal. A moderate excess was evident over the southeastern area and a small excess over the northern and eastern Gulf of Mexico, but on the other hand there was a considerable deficiency over waters near the coasts of Newfoundland, the Maritime Provinces, and New England.

The extremes of pressure in the vessel reports received were 1,035.2 and 970.5 millibars (30.57 and 28.66 inches). The high mark was noted on the American liner *Exeter* near 36° N., 36° W., late on the evening of the 22d. The low reading was reported by the U. S. Coast Guard cutter *General Greene*, near 48° N., 52° W., during the early afternoon of the 30th.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure (sea level) at selected stations for the North Atlantic Ocean and its shores, May 1941*

Station	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Millibars	*Millibars*	*Millibars*		*Millibars*	
Lisbon, Portugal	1,017.2	+2.3	1,031	3	1,004	17
Horta, Azores	1,023.1	+1.8	1,035	23	1,012	15
Belle Isle, Newfoundland	1,008.8	−3.4	1,027	14	986	31
Halifax, Nova Scotia	1,010.5	−4.4	1,025	28	993	18
Nantucket	1,012.2	−3.4	1,024	21	996	17
Hatteras	1,016.3	0.0	1,030	25	1,003	17
Turks Island [1]	1,015.6	−0.3	1,020	27, 28	1,006	1
Key West	1,015.9	+1.0	1,022	28	1,010	8
New Orleans	1,016.6	+1.7	1,023	15	1,006	6

[1] For 27 days.

NOTE.—All data based on available observations, departures compiled from best available normals related to time of observation, except Hatteras, Key West, Nantucket, and New Orleans, which are 24-hour corrected means.

Cyclones and gales.—The month seems to have been quieter over the North Atlantic than May usually is. The first 5 days and the final 8 included practically all the gales of note. In the entire month there were two whole gales (force 10) reported, but no storm of greater severity.

The earlier whole gale was met on the 15th by the Coast Guard cutter *Mojave*, which was at the time to southeastward of Nantucket. The later was encountered not far to eastward of Newfoundland on the 30th by the cutter *General Greene*. There had been a well-developed LOW over that part of the North Atlantic, shifting its position somewhat, for several days and it was joined on the 30th by a small-area vigorous cyclone which had developed over New York and New England early in the night of the 28th–29th and had advanced northeastward to beyond Newfoundland. It was at this time that the lowest known barometer reading of the month over the North Atlantic was noted, as mentioned above.

Duststorm.—The Hydrographic Bulletin of June 4 has a report of a duststorm near the North Carolina coast. The period, in ship's time, was approximately from midnight to dawn of the 18th.

From 0500 to 0900 G. C. T. on May 18, 1941, while steaming from a position off Cape Lookout Shoals Lighted Whistle Buoy 14 toward Frying Pan Shoals Lightship, a duststorm was encountered. The wind was westerly and the barometer was low (29.66 inches at midnight). At daybreak the bulkheads, booms, decks, etc., were found to be covered with fine brown dust that made little rivers of mud when being washed off with the deck hose.

Fog.—Somewhat less fog came to notice than during April just preceding. Particularly for the Gulf of Mexico and the waters just to eastward of the South Atlantic States, which had seen considerable April fog, there was none whatever reported in May except to northward of Cape Hatteras.

Between Capes Hatteras and Cod there was a marked decrease in amount of fog noted, the May dates for this strip being largely before the 12th. To eastward and northeastward of Cape Cod, as far as the eastern limits of Nova Scotia, May fog reports exceeded those for April. The period from the 7th to 11th is indicated as the foggiest part of May over these waters. The 5° square, 40° to 45° N., 65° to 70° W., furnished reports for 8 days.

The square, 40° to 45° N., 45° to 50° W., well to eastward of the American continent, is known to have had fog on 8 days, all during the middle decade of the month. These two squares just mentioned led all North Atlantic areas in reports of fog furnished.

When the fog conditions of previous Mays are compared with this year's showing, it appears that there was decidedly less than normal this year over waters just to eastward of the Middle Atlantic and New England States, but the absence of May fog near the coast from Hatteras to the Rio Grande is the usual condition.

OCEAN GALES AND STORMS, MAY 1941

Vessel	Voyage: From—	Voyage: To—	Position at time of lowest barometer: Latitude	Position at time of lowest barometer: Longitude	Gale began, May	Time of lowest barometer, May	Gale ended, May	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Direction and highest force of wind	Shifts of wind near time of lowest barometer
NORTH ATLANTIC OCEAN			° ′	° ′				*Millibars*					
Gulfhawk, Am. M. S.	Las Piedras, Venezuela.	New York	27 24 N.	74 18 W.	[1] 29	4a, 1	1	1,010.2	NE	NE, 7	NNE	ENE, 8	
Algic, Am. S. S.	Trinidad	Boston	37 26 N.	69 00 W.	2	4p, 2	3	1,005.4	NNE	NNE, 5	NE	NE, 8	None.
Gulfdawn, Am. S. S.	Port Arthur	Philadelphia	30 48 N.	79 30 W.	3	7p, 2	3	1,010.5	ENE	SSW, 4	ENE	NE, 8	SSW-W.
Nagara Maru, Jap. M. S.	Cristobal	New York	31 43 N.	74 03 W.	3	6a, 3	3	1,004.7	N	W, 4	N	N, 8	W-N.
Spencer, U. S. C. G.	On station No. 2		38 12 N.	45 30 W.	2	9a, 3	3	993.6	E	SSW, 7	NNW	E, 9	SE-SSW-NW.
Argentina, Am. S. S.	New York	Rio de Janeiro	1 24 N.	38 06 W.	2	3p, 3	3	1,009.1	E	ENE, 8	NE	ENE, 8	
Mojave, U. S. C. G.	On station No. 1		39 30 N.	58 54 W.	4	7a, 4	4	993.6	S	S, 8	WSW	S, 8	S-SW.
Spencer, U. S. C. G.	On station No. 2		38 36 N.	45 42 W.	5	2p, 5	5	1,002.0	SE	S, 8	WSW	SE, 9	SE-WSW.
Spencer, U. S. C. G.	On station No. 2		38 18 N.	46 30 W.	7	5a, 7	7	1,006.4	S	SW, 8	WNW	SW, 8	S-SW.
Mojave, U. S. C. G.	Newport	Station No. 1	39 12 N.	66 24 W.	14	1a, 15	15	1,006.4	N	NW, 6	WNW	NW, 10	NNW-NW.
Hamilton, U. S. C. G.	Norfolk	Station No. 2	36 42 N.	69 12 W.	18	1p, 17	18	1,004.4	WSW	SW, 3	WSW	WSW, 8	None.
Tampa, U. S. C. G.	On station No. 1		[2] 39 13 N.	59 18 W.	24	2a, 25	25	1,011.5	S	SSW, 8	SSW	SSW, 8	SSW-WNW.
Tampa, U. S. C. G.	On station No. 1		39 18 N.	59 18 W.	26	2a, 27	27	1,018.0	SW	WSW, 9	WNW	WSW, 9	SW-WNW-ENE.
General Greene, U. S. C. G.	Ice patrol		[2] 52 43 N.	44 29 W.	28	10a, 28	29	1,002.4	WSW	SW, 7	WSW	WSW, 8	SSW-WSW.
Tampa, U. S. C. G.	On station No. 1		39 42 N.	61 12 W.	29	5p, 29	30	1,001.4	W	WNW, 9	NNW	NW, 9	WSW-NW.
Hamilton, U. S. C. G.	On station No. 2		38 54 N.	45 54 W.	30	9a, 30	30	1,005.8	SSW	WSW, 8	S	SSW, 8	
General Greene, U. S. C. G.	Ice patrol		48 02 N.	51 51 W.	30	2p, 30	30	970.5	S	NNW, 5	W	ENE, 10	ENE-NW.
NORTH PACIFIC OCEAN													
President Coolidge, Am. S. S.	Yokohama	Honolulu	35 06 N.	151 30 E.	[1] 30	12p, 30[1]	2	989.2	E	W, 5	NNW	W, 11	S-W.
A vessel	Los Angeles	Vladivostok	40 42 N.	160 42 E.	2	2a, 2	2	995.3	E	ENE, 6	N	NE, 9	E-NE.
Satartia, Am. S. S.	Catabangan, P. I.	Los Angeles	41 42 N.	149 00 W.	2	10p, 2	3	991.9	SSE	SSW, 5	WSW	WSW, 9	S-SW.
Aurora, Am. M. S.	Los Angeles	Vladivostok	45 15 N.	153 05 E.	3	2p, 3	3	1,004.1	SSW	SW, 9	SW	SW, 9	SSW-SW.
Coldbrook, Am. S. S.	Yokohama	Vancouver, B. C.	49 30 N.	131 30 W.	3	4p, 4	3	990.9		SSE, 6		ESE, 8	
Pioneer, U. S. C. & G. Survey.	San Francisco	Dutch Harbor	45 06 N.	134 30 W.	4	3p, 4	5	993.9	SW	W, 7	W	WSW, 9	SW-W.
J. A. Moffett, Am. S. S.	do	Seward	46 54 N.	130 00 W.	4	1a, 5	5	992.6	WSW	WNW, 9	WSW	WNW, 9	WNW-WSW.
A vessel	Los Angeles	Vladivostok	41 42 N.	142 18 E.	5	4p, 5	5	995.3	S	W, 10	WSW	W, 11	S-W.
Aurora, Am. M. S.	do	do	42 30 N.	145 00 E.	5	4a, 5	5	986.8	SE	SE, 8	SE	SE, 9	SE-S.
China Arrow, Am. S. S.	Vladivostok	Los Angeles	49 12 N.	165 00 W.	9	1p, 9	9	1,004.4	SE	SE, 8	SSE	SE, 8	SE-SSE.
St. Mihiel, U. S. A. T.	Dutch Harbor	Seward	54 06 N.	163 00 W.	9	7p, 9	10	1,009.1		SE, 9		SE, 9	
Pioneer, U. S. C. & G. Survey.	San Francisco	Dutch Harbor	53 42 N.	164 06 W.	9	11a, 10	10	1,000.0	SSE	SSW, 4	SE	SE, 9	None.
Sanyo Maru, Jap. M. S.	Yokohama	San Francisco	46 42 N.	176 06 E.	10	12p, 11	10	1,006.1		S, 6		SW, 8	
Maliko, Am. S. S.	Honolulu	do	34 12 N.	133 06 W.	10	3p, 10	11	999.3	NW	WNW, 7	SSE	NW, 9	NW-W.
President Monroe, Am. S. S.	San Francisco	Honolulu	34 56 N.	131 40 W.	10	4p, 10	11	991.9	SE	WSW, 9	NNW	WSW, 9	SE-W.
Steel Navigator, Am. S. S.	do	do	35 00 N.	131 30 W.	10	2p, 10	11	990.9	SE	SSE, 7	WNW	WSW, 9	S-SSE-W.
Matsonia, Am. S. S.	do	do	35 30 N.	126 12 W.	10	6p, 10	11	989.5	S	SW, 7	NW	W, 9	S-W.
John R. R. Hannay, U. S. A. T.	Pearl Harbor	San Francisco	37 21 N.	138 35 W.	10	2a, 11	11	1,000.7	NW	NW, 8	N	N, 8	NW-N.
Makaweli, Am. S. S.	Honolulu	do	31 18 N.	140 12 W.	9	4a, 11	12	1,012.9	NNW	NW, 7	NW	NW, 8	
Pomona, Am. S. S.	Balboa	Los Angeles	14 33 N.	95 15 W.	12	4a, 13	13	1,012.2	N	NNE, 7	NE	NNE, 7	N-NE.
W. S. Miller, Am. S. S.	Shanghai	San Francisco	[2] 48 00 N.	168 44 W.	16	2a, 17	17	987.8	SSW	SSW, 9	W	SSW, 9	SSW-W.
Aurora, Am. M. S.	Vladivostok	Los Angeles	48 55 N.	169 20 W.	24	4a, 24	24	1,000.7	SE	SE, 9	SSW	SE, 9	SE-S.
Pioneer, U. S. C. & G. Survey.	Surveying near Aleutian Islands		52 18 N.	172 36 W.	24	1p, 24	24	979.7	SE	SE, 5	SW	SE, 9	ENE-SSW.
Discoverer, U. S. C. & G. Survey.	Surveying near Alaska Peninsula		55 06 N.	161 30 W.	24	6p, 24	25	1,011.9	ESE	SSE, 7	SSW	SSE, 8	ESE-SSE.
Pioneer, U. S. C. & G. Survey.	Surveying near Aleutian Islands		52 42 N.	172 30 W.	26	9p, 26	27	996.6	ESE	S, 5	SW	ESE, 11	SE-SW.

[1] April.
[2] Position approximate.

WEATHER ON THE NORTH PACIFIC OCEAN

By Willis E. Hurd

Atmospheric pressure.—The Aleutian low filled in rapidly, following its considerable depth in April, and in May lay as a great shallow depression stretching across the Aleutian Islands and the adjoining waters of the northern Pacific and the Bering Sea, average pressure about 1,009 millibars (29.80 inches) to slightly lower. Throughout this region the barometer was about 1 to 3 millibars below the normal of the month.

Anticyclones lay over much of the east-central part of the ocean through most of the month, and on several days extended northward into the Gulf of Alaska. The average center lay over and to the eastward of Midway Island. At this station the mean pressure, 1,022.6 millibars (30.20 inches), was 5 millibars (0.15 inch) above the May normal.

Low pressure lay over the extreme southwest, where the continental depression from China was slowly spreading over the adjacent sea.

Table 1.—*Averages, departures, and extremes of atmospheric pressure at sea level, North Pacific Ocean May 1941, at selected stations*

Station	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Millibars	*Millibars*	*Millibars*		*Millibars*	
Barrow	1,014.3	−4.7	1,030	11	1,000	31
Dutch Harbor	1,008.8	−1.7	1,024	21, 26	988	1
St. Paul	1,007.9	−3.3	1,027	21	990	13, 25
Kodiak	1,010.0	−0.5	1,025	10, 24, 27	992	4, 18
Juneau	1,012.9	−2.7	1,034	21	992	15
Tatoosh Island	1,015.2	−1.1	1,032	20	997	4
San Francisco	1,015.9	+0.3	1,024	5	1,003	10
Mazatlan	1,010.5	−0.3	1,013	16	1,006	18
Honolulu	1,015.9	−1.7	1,020	1	1,012	21
Midway Island	1,022.6	+5.0	1,028	21	1,016	2
Guam	1,010.8	−1.0	1,020	24	1,009	[1] 6
Manila	1,009.1	+1.0	1,014	4	1,006	19, 27
Hong Kong	1,009.5	+1.0	1,014	15, 16	1,003	26
Naha	1,012.5	+3.7	1,019	1	1,003	26
Titijima	1,015.1	+2.2	1,023	1, 2, 15	1,009	27
Petropavlovsk	1,008.9	−1.3	1,023	26	992	3

[1] And on other dates.

Note.—Data based on 1 daily observation only, except those for Juneau, Tatoosh Island, San Francisco, and Honolulu, which are based on 2 observations. Departures are computed from best available normals related to time of observation.

Cyclones and gales.—Cyclonic activity was confined to the western, northern, and eastern parts of the ocean. On a great expanse of middle waters south of the 40th parallel there were few disturbances and the weather was for the most part settled.

Early in the month some storminess occurred over both northwestern and northeastern quadrants of the Pacific within the period 1st to 5th. Early on the 1st the American S. S. *President Coolidge*, Yokohama to Honolulu, ran into fresh gale winds in the morning near 35° N., 152° E. In the afternoon the wind rose to force 11 from the west. During much of the night and the early morning of the 2d, gales continued of force 10, finally moderating to force 7 late in the afternoon. A vessel to the northeast of her, near 41° N., 170° E., on the 2d, had a highest velocity of force 9 from the northeast. On the 3d and 5th, associated with a cyclone over northern Japanese waters, three vessels reported southerly gales of force 9 south and east of the Kuril Islands.

On May 3 to 5 a moderately deep cyclone affected the northeastern Pacific, and was central off Queen Charlotte Island on the 5th. It caused force-9 gales at some distance west of the Washington coast on the 4th and 5th, the nearest of which to the mainland was encountered by the American S. S. *J. A. Moffett* near 47° N., 130° W., during the night of the two dates.

On the eastern half of the California-Hawaiian routes a disturbance appeared near 30° N., 135° W., on the 9th and disappeared close to the central California coast on the 13th. In connection with it, gales of force 8–9 occurred on the 10th and 11th roughly within the area 30° to 40° N., and from near the central California coast westward to about 140° W. The lowest barometer, 989.5 millibars (29.22 inches) was reported on the 10th, near 36° N., 126° W., by the American S. S. *Matsonia*.

Most storminess along the northern trans-Pacific routes occurred south of the central and eastern Aleutians during two periods of cyclonic activity, the 9th and 10th and the 24th to 26th. Southeasterly gales of force 8 to 9, accompanied by only a small depression of the barometer, were reported on the 9th and 10th south and east of the vicinity of Dutch Harbor.

From the 24th to 26th the deepest cyclone of the month moved northward across the central Aleutians into the Bering Sea, causing southeasterly gales along the eastern half of the group and vicinity, and south of the western part of the Alaska Peninsula. The United States Coast and Geodetic Survey vessel *Pioneer* recorded the lowest known barometer of the month, 979.7 millibars (28.93 inches), near 52° N., 173° W., on the 24th, preceded by a force-9 gale. The same vessel on the 26th encountered an east-southeast gale of force 11 in practically the same position.

In the Gulf of Tehuantepec a northeaster of force 7 occurred on the 13th, associated with high pressure over the western Gulf States.

Fog.—With advance of spring, the usual increase in fog on the North Pacific was seen this month. But while normally the greatest increase occurs on northwestern waters, this year in May the rise in fog frequency was distributed along practically the entire extent of the northern and central routes. The majority of 5° ocean areas between 35° and 50° N., had from 1 to 3 days with fog, as well as several such areas between 30° and 35° N. Fog was reported on 4 days in the western part of the Japan Sea, and on 4 days along the eastern shore of the Gulf of Alaska. California coastal waters had 9 days and Lower California waters 8 days on which fog was observed.

RIVER STAGES AND FLOODS

By BENNETT SWENSON

Except in the middle Plains States and Wyoming, precipitation during May was above normal throughout the western half of the country with amounts far above normal in most States. Minnesota, Wisconsin, and Louisiana had more than the usual amount for this month, but in all other States east of the Plains the amounts were below normal. Deficiencies were especially large from Kentucky and Virginia southward. South Carolina had only 13 percent of normal, Alabama 16 percent, and Georgia and Tennessee 26 percent. It was the driest May of record in Kentucky, Tennessee, Alabama, and South Carolina, and the second driest in Virginia, North Carolina, Georgia, and Mississippi.

For the winter and spring season (December to May) the East Central States, the entire Atlantic Seaboard except Florida, and the far Northwest showed a decided deficiency in precipitation.

Atlantic Slope and east Gulf of Mexico drainage.—Floods were entirely absent in this area and river stages were unusually low during May, except for flood stage at Pearl River, La., in the Pearl River, continuing from April until May 3. The mean monthly stage of the Connecticut River at Hartford, Conn., was 3.2 feet which is the lowest May mean river stage of record and the lowest reading of .0 foot during the month set a record low for May. Stream flow was considerably below normal in the Susquehanna River and approached a new all time low flow at Harrisburg, Pa., for May. In the Gulf drainage a low stage of 0.26 feet at Enterprise, Miss., on the Chickasawhay River, is the lowest stage of record for May in 37 years of record.

Upper Mississippi Basin.—From May 26 to the close of the month a quasi-stationary front extended in an east-west direction over the upper Mississippi River basin, situated between central Minnesota and central Iowa most of the time. Moderate to heavy rains occurred over this area during this time resulting in light to moderate flooding, and severe flooding in some localities.

Rains fell at a highly excessive rate in extreme northeastern Iowa and caused severe local flooding in this area. Reports on flood damages have not been obtained at this time.

Cautionary warnings were issued for the Root River and the Wisconsin River at Knowlton, Wis., stating that stages would approach flood stage. The damage from the high water was slight and confined to crop losses in the lowlands.

Stages in the main channel of the Mississippi River showed a gradual recession from the high water of April which was due to melting of the snow cover in the headwaters. The river was below flood stage except in the vicinity of Hannibal and Louisiana, Mo., where stages continued above flood during the first week of May.

Missouri River Basin.—A mass of Polar Maritime air moved rapidly southeastward across Nebraska and Kansas on May 19 and 20 with a cold front separating it from the tropical air to the south and east. Heavy rains occurred along the Kansas-Nebraska boundary as the warm moist air was lifted over the cold air mass. The rains were heavy over the Republican River watershed generally and especially on Medicine Creek. This creek was 4 feet above bankful during the night of the 19th and in the main channel the Republican River reached bankful and slightly above for about 15 miles in the vicinity of Guide Rock and Superior, Nebr.

Ohio River Basin.—Stages were unusually low during the month due to continued lack of precipitation. At Cincinnati, Ohio, the total precipitation for the first 5 months of the year, 6.05 inches was the least on record for that same period. In the Asheville, N. C., area the precipitation since August 1940 has been 50 percent of normal. The streamflow in the upper Tennessee River basin was near the all-time low during the month and the mean stage in the Ohio River at Cairo, Ill., for May was 16.3 feet, compared to the 60-year normal of 29.3 feet for that month.

Arkansas River Basin.—Heavy rains in the headwaters of the Canadian River in New Mexico at the close of April and the beginning of May caused severe flooding in that area. The river crested on the morning of the 3d at Union City, Okla., at a stage of 6 feet. Further heavy rains over this portion of the basin resulted in a second and higher crest of 10.8 feet at Union City on the night of the 4th. Crests at other points were 5.5 feet at Canadian, Tex., on the 3d, and 17.0 feet at Calvin, Okla., on the 5th.

Rains were again heavy during the latter half of the month, but flood stage was not reached as the result of these rains. However, flooding did occur in the North Canadian River at Woodward and Canton, Okla., on May 24–26 and at Yukon, Okla., stages were above flood the entire month. At Oklahoma City a stage of 14.0 feet was reached on May 4.

Red River Basin.—Heavy rains over the Little Missouri and Upper Ouachita watershed from May 4 to 6 resulted in flood stage being reached at Boughton, Ark., on the Little Missouri River and at Arkadelphia, Ark., on the Ouachita River, on May 7. At Camden, Ark., the Ouachita remained above flood stage from the 8th to the 14th, cresting at 31.8 feet (flood stage 26 feet) on May 10. The total loss has been estimated at $9,200 with a reported savings due to warnings of $5,000.

The Sulphur River reached record breaking stages early in the month with a crest stage of 32.0 feet at Ringo Crossing, Tex., on May 1, exceeding the high stage on June 17, 1935, and crest of 31.5 feet at Naples, Tex., on May 4, which is .2 foot lower than the record stage in May 19, 1930. These unusually high stages were the result of frequent rains during the spring months followed by heavy rains the latter half of April and the first of May.

The Little River, also a tributary of the Red River, reached flood stage at Whitecliffs, Ark., on May 3.

The Red River proper exceeded flood stage at Fulton, Ark., from May 8 to 11, at Grand Ecore, La., from May 10 to 18, and at Alexandria, La., from the 6th to 23d. The crest stage of 38.0 feet at Alexandria (6 feet above flood stage) occurred on May 16–17.

West Gulf of Mexico drainage.—The Trinity River which overflowed its banks twice during April at Dallas, Tex., was out of its banks at the close of April in the vicinity of Trinidad, Tex., and remained in flood there until May 17. At Dallas a flash rise reached a stage of 33.2 feet on May 6. In the lower reaches of the river stages were slightly above flood stage from May 7 to 26. The only report of damage was from Liberty, Tex., where losses amounting to $3,500 were sustained.

Heavy rains with resultant floods occurred over the watersheds of the Guadalupe and Nueces Rivers during the latter part of April and the first part of May. Extensive overflows from the Guadalupe covered 75,000 acres of farm lands as well as additional acres of pastures. Farm losses reached $78,500. The crest stage at Gonzales, Tex., was 31.3 feet on April 29, which is the highest stage during the past 4 years for that section of the Guadalupe. Another crest of 27.6 feet was reached on May 4. Along the lower portion of the river a crest of 29.5 feet occurred at Victoria, Tex., on May 3, equaling the crest of July 1940.

In the Nueces River the flood was confined to the lower portion where mostly pasture lands were flooded. The peak stage reached at Three Rivers, Tex., was 40.1 feet, and was the highest stage at that station in the past 5 years. Farm losses were estimated at approximately $7,100.

Moderate floods occurred also in the Brazos and Sabine Rivers from heavy rains during the first week of May. Flash floods in the smaller streams in Texas caused considerable damage. At Cameron, Tex., the Little River (tributary of the Brazos River) caused damage estimated at about $5,300. In the Plains and Panhandle sections of the State, excessive rains caused flash floods in local streams near Lubbock and Friona, Tex., with damage estimated at about $125,000.

The following report is made by the official in charge, Albuquerque, N. Mex., relative to floods in the Pecos River in New Mexico and the upper Rio Grande to and including Elephant Butte Reservoir Dam, N. Mex.:

The Pecos River was in flood stage from Artesia to Carlsbad at the beginning of the month and continued at that stage until May 5th. A flash flood occurred at 2 a. m., May 22, caused by excessive rainfall in the mountains west of Carlsbad. The greater portion of the water came down Hackleberry Draw and Dark Canyon. The river stage at Carlsbad changed from 8 feet to 20 feet within 2 hours. No lives were lost but considerable damage occurred. Several homes were washed away.

On the morning of May 23 at about 10 a. m., the second flood came down on Carlsbad from the same source as the first. This stage was considerably greater than the first one and did much damage. Although sufficient warnings had been issued 5 lives were lost in this second flood. About 111 homes were completely lost and 210 homes flooded and badly damaged; and about 1,500 people were homeless. So far, it has not been possible to obtain a fair estimate of the amount of damage to property and crops. This will be given in a later report.

The Pecos River reached flood stage the night of May 23 at Artesia and remained at high stage until close of the month. There was very little damage, however, from water in the main stream above Carlsbad. Flood waters in the Pecos caused the Red Bluff Dam to fill to capacity.

The Rio Grande was in flood stage from May 2 from Embudo to San Marcial. At the crest, about 25,000 second-feet were passing Albuquerque. The flood in this river has caused damage well over a million dollars, and a full report of the flood will be made as soon as the water subsides. As the river was still at flood stage at the close of the month, it is not practicable to make an accurate estimate of the damage. A full report of the flood in this river will be made at a later date.

The official in charge, El Paso, Tex., reports as follows on floods in the Pecos River in Texas and in the Rio Grande from Elephant Butte Dam to the mouth of the Pecos River:

Due to heavy thundershowers in the middle Pecos Valley watershed, in New Mexico on 4 days, beginning May 21, the Red Bluff Reservoir became full and began spilling on May 24. Heavy showers also fell in the Pecos River watershed in Texas immediately south of the Red Bluff Dam, during the same period, particularly on the 22d and 23d. A rapid, sudden inflow of water took place into the Pecos River and it overflowed at Mentone, Tex., about 20 miles south of the Dam, on the night of the 23d–24th. On the morning of the 25th the stage of the Pecos River at Pecos, Tex., 20 miles southeast of Mentone, was 8.7 feet, rising. Flood stage at Pecos is 13.0 feet.

River stages at Pecos during the remainder of the month were as follows: 26th, 12 feet, rising; 27th, 14 feet, rising; 28th, 14.4 feet, rising; 29th, 14.5 feet; 30th, 14.5 feet; and 31st, 14.5 feet.

The river enters a canyon at Sheffield, Tex., about 75 miles southeast of Pecos and remains therein until it empties into the Rio Grande and no overflows are possible.

The predicted overflows began to occur in the Pecos district on the 27th. Highways and 5,300 acres of irrigated farm land in Ward, Loving, and Reeves counties were flooded.

The flood continued after May 31. An effort will be made to obtain detailed estimates of loss when the flood subsides.

Heavy rains in the Rio Grande River watershed between La Nutria and Presidio, Tex., a distance of about 60 miles, on May 23 and 24, caused overflows in the River and arroyos in that section. The Presidio Valley is bordered both on the north and south by mountains, which are connected with the River by dry arroyos. This topographical formation, of course, is most favorable to quick run-offs.

Farm lands between Candelaria and Presidio were flooded both by adjacent arroyos and the River. The total losses from the two sources amounted to about $34,000 in Texas and $30,000 in Mexico.

While no flood stages were indicated in the lower Rio Grande, the river broke through some privately-owned levees below Brownsville, Tex., but no material damage resulted.

Gulf of California drainage.—High water and flooding occurred in the upper watershed of the Colorado River during the month. The high water resulted mainly from melting snow. Temperatures were unusually high in Colorado during the month and some rains occurred late in April and during the latter half of May.

There was considerable flooding in the Gunnison River which drains into the Colorado River above Grand Junction, Colo. The unusually high stage of 12.7 feet was reached at Delta, Colo., on May 14. In the Colorado River flood stage was exceeded slightly at Grand Junction with a peak stage of 11.2 feet on May 15. Damages have been estimated at $120,000 in this area.

The San Juan River, also a tributary of the Colorado River, was at flood stage from May 12 to 17 in the vicinity of Farmington, N. Mex. The river crested at 40,000 second-feet at that place on May 15. A further report on this flood will be made at a later date.

Pacific Slope drainage.—Stages above flood occurred in the Kings River at Piedra, Calif., several times during the month. The highest stage reached was 11.25 feet on May 24. The high water was due to the melting of snow in the elevated regions. Additional areas in Tulare Lake Basin are being flooded by the annual rise in the Kings, Kaweah, Tule, and Kern Rivers. These streams have not yet reached the seasonal peak.

Table of estimated flood losses and savings for May 1941

River and drainage	Tangible property	Prospective crops	Livestock and other movable farm property	Suspension of business	Total losses	Total savings
MISSISSIPPI SYSTEM						
Red Basin						
Ouachita River	$2,500	$2,000	$700	$4,000	$9,200	$5,000
WEST GULF OF MEXICO						
Trinity River	3,000			500	3,500	5,000
Brazos River	30,300	100,000			130,300	
Guadalupe River [1]	8,000	75,000	3,500	14,000	100,500	17,500
Nueces River [1]	2,500	4,600	350	1,800	9,250	
GULF OF CALIFORNIA						
Gunnison and Colorado Rivers	36,000	84,000			120,000	
Salt River [2]	196,300				196,300	

Data for Rio Grande and Pecos Rivers not available.

[1] April and May.
[2] Flood of March 1941.

FLOOD-STAGE REPORT FOR MAY 1941

[All dates in May unless otherwise specified]

River and station	Flood stage	Above flood stages—dates: From—	Above flood stages—dates: To—	Crest: Stage	Crest: Date
EAST GULF OF MEXICO DRAINAGE	*Feet*			*Feet*	
Pearl: Pearl River, La	12	(1)	3		
MISSISSIPPI SYSTEM					
Upper Mississippi Basin					
Mississippi:					
Hannibal, Mo	13	(1)	4		
Louisiana, Mo	12	(1)	(2) (3)		
Missouri Basin					
Republican: Guide Rock, Nebr	9	21	21	9.3	21
White Basin					
White:					
Georgetown, Ark	21	(1)	2		
Clarendon, Ark	26	2	5	26.2	4
Arkansas Basin					
Cimarron: Perkins, Okla	11	5	6	12.75	6
		22	22	11.9	22
		24	24	11.1	24
Neosho: Wyandotte, Okla	23	(1)	(2)	33.2	2-3
North Canadian:					
Woodward, Okla	5	5	5	5.0	5
		23	24	6.6	24
Canton, Okla	8	5	5	9.1	5
		21	21	8.5	21
		23	27	11.4	26
Yukon, Okla	8	(1)	(2)	[4] 13.0	23
Oklahoma City, Okla	12	4	5	14.0	4
(East) Oklahoma City, Okla	14	4	5	15.4	5
Canadian:					
Canadian, Tex	5	3	3	5.5	3
Union City, Okla	6	3	5	10.8	4
Calvin, Okla	15	5	5	17.0	5
Red Basin					
Little Missouri: Boughton, Ark	20	7	7	20.1	7
Ouachita:					
Arkadelphia, Ark	17	7	7	17.1	7
Camden, Ark	26	(1)	1		
		7	14	31.8	10
Little: Whitecliffs, Ark	25	2	4	25.4	3
Sulphur:					
Ringo Crossing, Tex	20	(1)	14	32.0	1
				27.0	11
Naples, Tex	22	(1)	19	31.5	4
Red:					
Fulton, Ark	25	5	5	25.0	5
		7	12	26.4	10
Grand Ecore, La	33	9	19	36.0	15
Alexandria, La	32	5	24	38.0	16–17
WEST GULF OF MEXICO DRAINAGE					
Sabine: Logansport, La	25	7	7	25.0	7
		8	15	26.4	12
Trinity:					
Dallas, Tex	28	5	7	33.2	6
Trinidad, Tex	28	(1)	17	36.2	14
Long Lake, Tex	40	10	16	41.6	13
Liberty, Tex	24	6	15	26.0	10-12
		20	26	24.9	24
Brazos: Waco, Tex	27	5	6	28.8	5
Colorado: Wharton, Tex	26	4	4	26.4	4
Guadalupe:					
Gonzales, Tex	20	(1)	1		
		3	7	27.6	4
Victoria, Tex	21	(1)	11	29.5	3
		23	24	22.3	23
Nueces: Three Rivers, Tex	37	(1)	1	39.5	Apr. 30
		4	8	40.1	5
GULF OF CALIFORNIA DRAINAGE					
Colorado Basin					
North Fork of Gunnison: Paonia, Colo	9	4	4	9.0	4
		8	15	9.9	13
		17	18	9.0	17–18
Gunnison: Delta, Colo	9	4	6	9.4	5
		7	20	12.7	14
		27	27	9.1	27
San Juan: Farmington, N. Mex	7	13	15	7.8	14
Colorado: Grand Junction, Colo	11	14	15	11.2	15
PACIFIC SLOPE DRAINAGE					
San Joaquin Basin					
Kings: Piedra, Calif.[5]	10	10	12	11.1	12
		17	18	10.35	18
		21	28	11.25	24

[1] Continued from previous month.
[2] Continued into following month.
[3] Occasionally at or above flood stage due to operations of Dam No. 24.
[4] Gage inaccessible during high water on May 5, 7, 23, 27–30; crest estimated.
[5] Data furnished by the Kings River Water Association.

CLIMATOLOGICAL DATA

CONDENSED CLIMATOLOGICAL SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS

[For description of tables and charts, see REVIEW, January, p. 31]

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amount are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Section	Temperature								Precipitation					
			Monthly extremes								Greatest monthly		Least monthly	
	Section average	Departure from the normal	Station	Highest	Date	Station	Lowest	Date	Section average	Departure from the normal	Station	Amount	Station	Amount
	° F.	° F.		° F.			° F.		In.	In.		In.		In.
Alabama	73.5	+2.1	4 station	100	[1] 21	Centerville	33	13	0.66	−3.46	Shottsville	2.62	2 stations	0.00
Arizona	65.4	−.7	Mohawk	109	8	Alpine	15	20	.74	+.42	Roosevelt	1.88	6 stations	.00
Arkansas	71.4	+2.2	Dumas	97	[1] 21	Gilbert	40	13	2.22	−2.68	Hope	6.25	Marked Tree	.31
California	62.3	+.9	3 stations	109	10	Tamarack	13	18	1.21	+.27	Scales	7.41	22 stations	.00
Colorado	55.5	+3.1	do	98	13	2 stations	10	[1] 1	2.13	+.24	Redvale	6.94	Grand Lake	.10
Florida	74.3	−1.2	Blountstown	101	23	do	42	14	1.48	−2.43	Belle Glade	7.68	2 stations	.00
Georgia	72.8	+1.2	2 stations	103	[1] 23	Blairsville	20	14	.90	−2.48	Resaca	2.48	Midville	.10
Idaho	54.3	+1.1	do	97	11	Obsidian (near)	18	19	2.98	+1.34	Deception Creek	8.46	Burley	.41
Illinois	67.0	+4.2	Mt. Vernon	99	21	2 stations	30	10	3.09	−.91	Sycamore	7.84	Vandalia	1.06
Indiana	65.4	+3.1	3 stations	99	[1] 22	Marengo	26	12	2.24	−1.72	Hobart	5.04	Anderson	.62
Iowa	66.0	+5.8	Howarden	97	14	Decorah	31	24	3.26	−.76	Decorah	12.21	2 stations	.55
Kansas	67.9	+3.9	St. Francis	102	13	Colby	35	8	3.54	−.28	Liberal	9.30	Walnut	.72
Kentucky	67.7	+2.3	Covington	101	21	Farmers	30	13	1.20	−2.71	Paducah	2.74	Eubank	1.23
Louisiana	74.0	+.3	3 stations	98	[1] 24	2 stations	48	[1] 11	7.61	+3.02	Jennings	20.97	New Orleans (airport)	1.17
Maryland-Delaware	64.3	+1.6	Dundalk, Md	100	28	Oakland, Md	20	13	2.19	−1.31	Crisfield. Md	3.80	2 stations	1.06
Michigan	57.8	+4.3	Eloise	95	21	Kenton	15	10	2.77	−.42	Sack Bay	5.42	Sebewaing	.65
Minnesota	60.5	+5.2	3 stations	95	14	Redby	21	9	3.45	+.27	Springfield	7.63	Worthington	.61
Mississippi	73.4	+1.6	2 stations	99	[1] 22	2 stations	41	13	1.39	−2.88	Woodville	6.88	Shubuta	.12
Missouri	68.9	+4.4	Sikeston	97	21	Goodland	35	13	2.30	−2.38	Tarkio	6.18	Caruthersville	.35
Montana	54.9	+2.7	5 stations	96	[1] 12	Conway's Ranch	17	19	2.24	+.15	Trout Creek (near)	5.83	Deer Lodge	.45
Nebraska	64.8	+5.4	St. Paul	103	14	Gordon	24	23	2.28	−1.11	Tecumseh	6.06	Valentine	.60
Nevada	57.7	+2.0	Overton	112	10	Austin	15	19	.98	+.12	Lamoille	4.25	Mina	.00
New England	56.1	+1.0	Manchester, N. H.	96	22	Somerset, Vt	20	3	2.66	−.68	Storrs, Conn	5.08	Block Island, R. I	.92
New Jersey	62.6	+2.2	Chatsworth	99	22	Layton	23	3	1.86	−1.82	Hightstown	3.21	Tuckerton	.93
New Mexico	59.8	+.2	Orogrande	101	10	Lee Ranch	18	2	4.50	+3.24	Portales Evap. Station.	16.21	Culberson Ranch	.23
New York	57.8	+1.8	Poughkeepsie	98	22	2 stations	20	3	1.87	−1.53	Scarsdale	4.64	Spier Falls	.56
North Carolina	68.5	+1.7	Belhaven	105	29	Banners Elk	25	14	1.14	−2.86	Reidsville	3.31	Monroe	.04
North Dakota	58.3	+4.6	3 stations	98	18	Wishek	21	23	2.94	+.64	Bowbells	6.28	Fargo	.98
Ohio	63.4	+2.8	Portsmouth	97	22	Millport	26	[1] 11	2.60	−1.06	Lima	5.41	Versailles	.83
Oklahoma	70.9	+2.5	Hollis	97	14	Goodwell	41	2	4.79	+.10	Hollis	12.20	Sallisaw	.48
Oregon	53.9	+.6	2 stations	99	22	Fremont	13	20	3.19	+1.47	Headworks	9.97	2 stations	.86
Pennsylvania	61.4	+1.8	Marcus Hook	102	27	2 stations	21	[1] 12	2.25	−1.56	Lycippus	6.01	McKeesport	.37
South Carolina	72.2	+1.3	Blackville	105	23	Longcreek (near)	33	14	.46	−3.04	Caesars Head	1.78	Winthrop College	.00
South Dakota	62.8	+6.2	Pierre	99	13	Pollock	22	23	1.77	−1.04	Pierre	4.34	Highmore	.34
Tennessee	69.7	+2.8	Clarksville	99	[1] 21	Rugby	31	13	1.06	−3.04	McKenzie	3.84	Sneedville	.06
Texas	73.3	+.3	Presidio	106	10	Mt. Locke	34	3	5.65	+2.01	Bon Wier	18.71	Del Rio	1.21
Utah	57.0	+1.5	Toquerville	100	11	Kimberly	17	19	1.41	+.21	Corinne	4.85	Callao	.07
Virginia	66.1	+2.0	5 stations	101	[1] 22	2 stations	25	[1] 3	1.00	−2.57	Warsaw	2.73	Moores Creek Dam	.04
Washington	55.2	+.5	Mottinger	96	23	Stockdill Ranch	20	9	3.60	+1.70	Big Four	15.15	White Swan	.27
West Virginia	62.2	+.5	Hinton	102	22	2 stations	20	[1] 3	2.28	−1.66	2 stations	4.45	2 stations	.57
Wisconsin	60.2	+4.8	Richland Center	92	20	Long Lake	15	10	4.19	+.60	Dodgeville	7.27	Iron River	1.40
Wyoming	53.3	+3.6	Torrington	97	13	2 stations	11	[1] 6	1.53	−.49	Snake River	4.49	Diversion Dam	.10
Alaska (April)	32.3	+5.5	Wrangell	76	25	Barrow	−15	16	1.60	+.21	Latouche	37.17	Tanana	.01
Hawaii	71.4	+.2	3 stations	92	[1] 19	Haleakala	33	9	7.93	+1.72	Kukui	59.00	7 stations	.00
Puerto Rico	78.0	+1.4	Manati	99	18	2 stations	54	9	9.72	+1.99	La Mina (El Yunque).	26.07	Yauco	.65

[1] Other dates also.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max.+mean min.÷2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01 inch or more	Wind: Average hourly velocity	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0-10	In.	In.
New England							56.2	+1.6										68	2.26	-0.9										5.2		
Eastport	75	67	85	29.76	29.84	-0.12	48.2	+0.5	73	16	56	32	1	41	28	44	41	82	3.19	+0.2	14	9.4	s.	31	nw.	25	9	12	10	5.7	T	0.0
Greenville, Maine	1,070	6	41	28.72	29.87	----	50.4	----	88	22	65	26	12	36	51	46	40	---	2.04	-1.3	13	----	n.	----	----	---	8	10	13	----	T	.0
Portland, Maine[1]	103	5	36	29.76	29.86	-.11	55.0	+1.7	85	16	67	34	4	43	44	48	43	67	1.46	-1.9	15	7.5	w.	27	w.	25	13	7	11	5.3	0.0	.0
Concord[2]	289	54	72	29.57	29.88	-.10	55.2	+.9	90	22	71	25	4	39	51	50	44	65	2.38	-.6	10	7.4	nw.	33	nw.	25	10	11	10	5.5	.2	.0
Burlington[2]	403	11	48	29.46	29.90	-.07	55.3	-1.2	87	21	67	29	3	44	38	50	43	63	2.14	-.7	11	7.2	n.	30	se.	7	11	8	12	5.4	T	.0
Northfield	876	12	60	28.96	29.88	-.09	52.8	.0	89	21	67	24	3	38	49	---	---	---	1.95	-.8	11	7.2	n.	27	n.	24	8	11	12	5.6	T	.0
Boston[1]	124	33	62	29.74	29.88	-.10	59.8	+2.7	92	22	69	36	3	50	32	51	44	60	2.43	-.8	13	10.6	w.	29	ne.	2	8	9	14	6.1	T	.0
Nantucket	12	10	63	29.87	29.89	-.10	55.2	+2.9	82	23	63	38	1	47	27	50	46	76	1.92	-.9	8	10.7	sw.	28	ne.	3	14	9	8	4.7	.0	.0
Block Island	26	11	46	29.87	29.90	-.09	55.5	+2.7	84	23	64	36	2	48	27	40	45	74	.92	-2.6	6	13.9	w.	38	ne.	2	16	10	5	3.4	T	.0
Providence[2]	159	65	251	29.72	29.90	-.08	60.6	+2.1	94	22	71	36	3	50	36	52	46	65	3.10	+.1	12	11.2	nw.	34	nw.	25	10	11	10	5.4	.0	.0
Hartford[1]	159	5	44	29.73	29.90	-.08	59.6	+2.1	91	22	73	32	3	46	40	52	46	65	3.14	-.6	8	8.6	s.	34	n.	24	6	15	10	5.8	.0	.0
New Haven[2]	107	5	39	29.80	29.92	-.07	60.7	+2.8	87	22	71	35	3	50	32	52	45	64	2.26	-1.4	8	8.5	nw.	27	nw.	24	8	17	6	4.6	.0	.0
Middle Atlantic States							64.9	+2.6										59	1.56	-1.9										4.6		
Albany[1]	97	26	40	29.80	29.91	-.07	59.3	.0	92	21	73	30	3	46	40	51	43	57	1.19	-1.7	8	9.4	w.	38	n.	2	9	10	12	5.8	.0	.0
Binghamton	871	57	79	29.04	29.97	-.01	58.2	+.8	91	21	71	31	13	43	40	51	45	65	2.09	-1.2	13	5.8	nw.	21	nw.	24	7	10	14	6.5	.0	.0
New York	314	415	454	29.58	29.92	-.07	63.0	+2.4	91	22	73	38	3	53	31	53	44	57	1.52	-1.7	9	14.3	nw.	51	nw.	24	10	12	9	5.2	.0	.0
Harrisburg[1]	374	30	49	29.56	29.96	-.02	65.4	+3.6	96	22	78	38	4	52	42	55	47	56	1.93	-1.5	10	7.9	w.	26	n.	22	9	13	9	5.5	.0	.0
Philadelphia[2]	114	174	367	29.83	29.96	-.03	66.3	+3.4	94	22	77	39	3	55	31	56	48	50	.87	-2.4	9	11.9	nw.	38	n.	22	11	16	4	4.4	.0	.0
Reading	323	47	306	29.61	29.95	----	65.3	+3.3	95	22	78	38	3	53	34	55	45	52	1.57	-2.1	10	10.3	nw.	36	n.	2	14	10	7	4.5	.0	.0
Scranton	805	72	104	29.10	29.95	-.03	60.6	+1.2	91	21	73	33	3	48	37	---	---	---	1.95	-1.3	12	6.7	n.	29	nw.	24	10	15	6	4.8	.0	.0
Atlantic City	52	37	172	29.89	29.95	-.03	62.8	+4.7	93	27	72	39	3	54	32	54	49	66	1.47	-1.6	11	13.4	s.	41	ne.	2	13	14	4	4.3	.0	.0
Trenton	190	89	107	29.74	29.94	----	64.4	+3.3	95	22	76	37	3	52	33	54	46	56	1.39	-1.7	10	8.7	nw.	34	nw.	22	7	14	10	5.8	.0	.0
Baltimore[2]	123	100	215	29.84	29.96	-.03	68.3	+3.9	98	22	80	41	3	57	34	57	50	58	3.61	+.1	10	10.8	sw.	39	sw.	23	16	9	6	4.3	.0	.0
Washington	112	62	85	29.85	29.97	-.03	66.8	+3.1	97	28	79	41	3	55	37	56	48	56	1.58	-2.1	12	7.1	nw.	29	nw.	23	14	11	6	4.2	.0	.0
Cape Henry	18	8	54	29.96	29.98	----	67.2	+3.0	95	29	76	42	4	58	31	58	53	66	.85	-2.7	7	11.9	sw.	45	ne.	29	18	10	3	3.5	.0	.0
Lynchburg	686	144	184	29.28	30.02	+.02	68.4	+1.1	100	22	82	36	4	54	44	57	48	53	.52	-3.1	4	7.5	nw.	32	nw.	9	15	12	4	4.0	.0	.0
Norfolk[2]	91	80	125	29.90	30.00	.00	69.6	+3.4	98	28	80	45	4	59	35	58	53	65	.94	-2.9	7	9.7	w.	37	nw.	23	16	11	4	3.9	.0	.0
Richmond[2]	144	11	52	29.84	29.99	.00	68.6	+2.1	98	28	81	42	12	56	37	58	51	62	1.88	-1.9	7	7.4	nw.	29	n.	23	20	8	3	3.0	.0	.0
South Atlantic States							71.6	+1.4										63	0.87	-2.6										3.2		
Asheville	2,253	89	104	27.74	30.05	+.06	65.6	+3.0	93	21	79	36	14	52	41	55	48	60	1.51	-1.9	7	6.6	nw.	25	nw.	9	17	10	4	3.6	.0	.0
Charlotte[1]	779	63	86	29.20	30.02	+.03	72.0	+3.1	98	23	84	46	4	60	32	59	52	56	.21	-3.4	5	6.8	sw.	32	nw.	17	18	10	3	3.4	.0	.0
Greensboro[1]	886	6	56	29.10	30.03	----	67.8	----	98	29	82	35	4	54	40	57	50	58	1.42	----	5	8.0	sw.	26	w.	9	15	12	4	3.8	.0	.0
Hatteras	11	5	50	30.00	30.01	.00	66.5	-2.2	84	29	73	47	4	60	22	61	58	78	1.89	-1.6	6	12.7	sw.	49	nw.	23	17	10	4	4.3	.0	.0
Raleigh[1]	376	27	69	29.62	30.02	+.03	70.2	+1.7	99	28	84	38	4	56	37	59	52	59	2.08	-1.7	6	9.3	sw.	56	w.	17	20	5	6	3.7	.0	.0
Wilmington	72	73	107	29.95	30.02	+.01	70.4	-.4	94	23	81	45	4	60	30	61	56	68	.86	-2.6	4	9.9	sw.	27	s.	7	22	4	5	3.1	.0	.0
Charleston[2]	48	11	92	29.98	30.04	+.03	73.0	+.3	95	16	81	54	14	65	29	62	58	71	.07	-2.9	2	10.9	sw.	28	ne.	3	23	5	3	2.7	.0	.0
Columbia, S. C.[2]	347	70	91	29.66	30.03	+.03	73.8	+1.9	100	22	86	48	4	61	34	61	53	55	.51	-2.5	6	8.6	s.	23	ne.	3	25	3	3	2.5	.0	.0
Greenville, S. C.	1,040	70	78	28.96	30.04	----	72.4	+5.2	98	22	84	47	14	61	33	---	---	---	.78	-3.2	3	7.1	sw.	23	sw.	15	19	8	4	3.4	.0	.0
Augusta[1]	182	62	77	29.83	30.02	+.03	74.4	+2.0	99	23	87	48	14	62	34	60	51	52	.20	-2.8	1	5.9	s.	20	w.	9	23	4	4	2.9	.0	.0
Savannah[2]	65	73	152	29.98	30.04	+.04	74.5	+1.1	98	30	85	54	13	64	33	63	58	66	.43	-2.6	1	10.5	sw.	29	e.	3	21	8	2	2.4	.0	.0
Jacksonville[2]	43	86	110	30.00	30.05	+.05	74.6	-.4	94	30	85	55	14	64	29	64	59	67	1.04	-3.0	2	7.4	se.	22	ne.	3	18	12	1	3.1	.0	.0
Florida Peninsula							76.8	-0.4										72	0.21	-4.0										4.1		
Key West[2]	21	10	64	29.98	30.00	+.03	78.0	-1.1	86	11	83	68	3	73	14	71	68	75	.14	-3.4	2	10.8	e.	23	e.	26	10	14	7	5.0	.0	.0
Miami[2]	25	124	168	29.99	30.02	+.03	76.3	-.1	86	10	81	63	14	72	18	68	64	71	.32	-5.9	6	9.6	e.	23	se.	7	12	14	5	4.6	.0	.0
Tampa[1]	35	5	61	30.00	30.03	+.04	76.2	-.1	91	9	86	58	2	66	25	67	63	70	.16	-2.8	2	11.3	e.	41	sw.	7	19	11	1	2.5	.0	.0
East Gulf States							74.1	+1.4										67	1.54	-2.3										4.1		
Atlanta[1]	1,173	5	72	28.82	30.02	+.03	72.6	+2.7	97	29	85	44	14	60	36	60	52	55	.47	----	3	8.9	nw.	26	n.	23	17	10	4	3.4	.0	.0
Macon[2]	370	79	87	29.64	30.02	+.03	73.4	+1.1	98	23	86	44	14	61	38	61	53	56	1.41	-1.4	3	6.8	s.	20	nw.	9	18	11	2	3.5	.0	.0
Thomasville	273	49	58	29.77	30.06	+.07	75.0	+1.0	98	24	88	52	13	62	35	---	---	---	1.60	-1.9	2	----	----	----	----	---	10	15	6	----	.0	.0
Apalachicola	35	11	51	30.00	30.04	----	74.4	-.2	91	9	82	57	14	67	24	67	63	72	.55	-2.8	1	8.8	se.	26	e.	4	12	15	4	4.0	.0	.0
Pensacola	56	54	79	29.98	30.04	+.05	74.0	+.1	96	24	81	57	14	66	26	67	63	72	1.24	-2.1	3	8.0	se.	24	se.	6	18	6	7	3.6	.0	.0
Anniston	741	9	----	----	----	----	71.4	+3.0	94	21	85	40	13	58	39	---	---	---	1.27	-2.6	7	----	se.	----	----	---	19	11	1	----	.0	.0
Birmingham[2]	700	11	48	29.31	30.04	+.06	73.6	+2.5	95	28	85	46	13	62	29	61	55	62	1.05	-2.9	7	6.2	n.	23	se.	6	15	11	5	4.1	.0	.0
Mobile[2]	57	86	161	29.98	30.04	+.05	75.0	+.6	95	24	84	55	14	65	27	66	62	74	1.42	-2.9	2	10.0	s.	32	se.	5	10	13	8	4.8	.0	.0
Montgomery[2]	218	92	105	29.80	30.03	+.04	75.8	+2.4	96	23	87	52	14	65	30	63	57	60	.68	-3.2	1	6.7	n.	18	n.	9	18	8	5	3.3	.0	.0
Meridian[2]	375	67	92	29.64	30.03	+.05	73.8	+2.5	94	23	86	47	13	62	32	64	59	67	.50	-3.8	5	5.3	s.	19	se.	5	14	11	6	4.3	.0	.0
Vicksburg[2]	247	82	102	29.75	30.01	+.04	73.8	+.9	91	23	83	55	11	64	28	65	62	77	4.05	-.3	7	7.7	se.	30	se.	5	14	8	9	4.8	.0	.0
New Orleans[2]	53	76	84	29.96	30.02	+.05	76.8	+1.4	94	24	85	64	11	68	23	68	63	71	3.06	-1.5	8	6.7	se.	24	se.	5	10	11	10	5.2	.0	.0
West Gulf States							74.9	+1.6										78	4.27	+0.1										6.0		
Shreveport[2]	249	92	227	29.72	29.99	+.04	75.0	+1.4	91	22	84	57	10	66	24	67	63	74	8.52	+4.3	8	10.0	s.	29	ne.	5	11	8	12	5.5	.0	.0
Bentonville	1,303	12	51	28.67	30.02	+.09	69.9	+3.5	90	31	81	47	12	58	30	---	---	---	.64	-4.6	6	6.6	s.	21	sw.	14	9	13	9	4.7	.0	.0
Fort Smith	463	57	82	29.49	29.96	+.03	73.4	+3.8	90	22	83	56	8	64	30	64	58	65	2.19	-2.6	10	7.0	e.	24	sw.	14	7	19	5	5.2	.0	.0
Little Rock[2]	357	94	102	29.63	30.01	+.06	72.5	+2.2	90	22	82	57	11	64	28	64	61	74	4.10	-.7	5	7.3	s.	30	nw.	23	8	8	15	6.3	.0	.0
Austin[2]	605	68	90	29.31	29.94	----	75.0	+.4	91	31	84	56	3	66	28	68	66	80	3.85	-.8	8	7.2	s.	29	ne.	2	5	15	11	6.2	.0	.0
Brownsville[2]	57	88	96	29.84	29.90	----	77.6	-1.0	89	30	85	64	5	71	22	71	70	84	3.97	+1.7	9	10.2	se.	40	n.	5	6	14	11	6.0	.0	.0
Corpus Christi[2]	20	11	78	29.91	29.93	+.03	77.4	+1.2	89	31	83	63	2	72	17	72	71	89	10.44	+7.2	8	11.5	se.	34	ne.	2	6	12	13	6.0	.0	.0
Dallas[1]	512	6	46	29.41	29.95	----	75.4	----	92	31	85	55	12	66	29	67	64	75	2.12	-2.4	9	10.6	se.	34	s.	14	7	5	19	6.6	.0	.0
Fort Worth[1]	679	35	56	29.24	29.94	+.03	75.6	+3.3	95	31	86	55	12	65	28	67	64	77	2.02	-2.6	8	10.6	se.	31	e.	3	5	12	14	6.6	.0	.0
Galveston[2]	54	106	114	29.91	29.97	+.03	75.7	+.9	84	10	80	62	5	72	14	70	68	81	4.41	+1.0	8	11.2	s.	42	sw.	5	9	11	11	5.6	.0	.0
Houston[2]	138	157	190	29.83	29.97	----	76.6	+1.1	92	25	84	62	3	69	22	69	67	82	5.33	+.8	11	10.1	se.	31	nw.	5	4	13	14	6.5	.0	.0
Palestine	510	64	72	29.46	29.98	+.05	74.0	+1.3	89	17	83	58	13	65	25	67	63	74	3.56	-1.0	10	7.3	s.	20	s.	14	6	13	12	5.9	.0	.0
Port Arthur	34	59	134	29.94	29.98	----	76.2	----	91	24	83	64	5	70	23	---	---	---	6.07	+2.0	8	13.1	se.	49	sw.	5	8	12	11	5.5	.0	.0
San Antonio[1]	693	28	59	29.22	29.93	+.03	76.3	+1.2	93	31	86	57	3	66	27	69	67	79	2.50	-.7	8	8.1	se.	37	nw.	2	1	15	15	7.3	.0	.0

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation: Thermometer above ground	Elevation: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature: Mean max.+mean min.÷2	Temperature: Departure from normal	Temperature: Maximum	Temperature: Date	Temperature: Mean maximum	Temperature: Minimum	Temperature: Date	Temperature: Mean minimum	Temperature: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01 inch or more	Wind: Average hourly velocity	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0-10	In.	In.
Ohio Valley and Tennessee							66.9	+2.0										61	1.98	-1.8										4.3		
Chattanooga [1]	762	21	54	29.23	30.03	+0.04	69.8	+1.0	99	29	85	36	14	55	46	60	54	63	0.54	------	5	6.1	s.	23	w.	8	19	8	4	3.6	0.0	0.0
Knoxville [2]	995	66	84	29.00	30.04	+.05	70.5	+3.3	96	22	83	42	14	58	38	58	51	57	.71	-3.0	5	5.3	w.	20	nw.	8	15	12	4	3.5	.0	.0
Memphis [2]	399	78	86	29.60	30.01	+.05	73.0	+2.4	94	22	84	47	13	62	37	63	57	64	.99	-3.2	5	7.1	sw.	22	sw.	14	14	11	6	4.5	.0	.0
Nashville [2]	546	167	187	29.45	30.03	+.05	71.2	+3.0	95	22	82	47	10	60	35	60	54	58	.87	-3.0	3	8.4	nw.	30	nw.	11	15	11	5	4.1	.0	.0
Lexington	989	6	----	29.00	30.06	+.07	67.1	+2.8	96	22	81	37	12	53	39	----	----	---	1.72	-2.1	6	------	------	------	------	---	21	8	2	2.8	.0	.0
Louisville [2]	525	106	120	29.47	30.03	+.05	68.6	+2.0	94	22	80	43	10	57	34	58	51	59	1.25	-2.5	6	8.6	sw.	38	nw.	16	16	13	2	3.2	.0	.0
Evansville [1]	431	5	38	29.56	30.02	+.05	67.6	+.9	93	21	80	39	12	55	36	59	53	62	2.13	-1.7	9	7.7	n.	42	nw.	16	13	13	5	4.5	.0	.0
Indianapolis [2]	823	98	129	29.14	30.02	+.05	66.9	+4.0	93	22	78	36	10	56	36	56	49	62	1.12	-2.7	8	7.8	sw.	29	nw.	8	11	11	9	5.0	.0	.0
Terre Haute [2]	575	68	149	29.42	30.03	------	68.0	------	94	21	79	40	10	57	35	58	52	63	3.43	-.4	11	9.0	s.	31	sw.	21	11	11	9	5.1	.0	.0
Cincinnati [2]	627	11	51	29.36	30.02	+.03	66.9	+3.8	93	22	79	40	12	54	38	57	50	60	.85	-2.8	8	6.7	sw.	27	nw.	8	14	10	7	4.8	.0	.0
Columbus [2]	822	90	110	29.15	30.02	+.04	65.2	+2.9	93	22	77	40	12	53	35	55	48	60	2.47	-1.1	9	8.9	s.	34	s.	7	12	9	10	5.1	.0	.0
Dayton [2]	900	186	213	29.08	30.03	------	65.3	+2.7	91	29	77	41	12	54	37	55	48	59	2.77	-.8	7	9.4	sw.	31	sw.	27	10	13	8	4.7	.0	.0
Elkins [2]	1,947	61	78	28.01	30.04	+.04	58.8	-.4	88	22	74	28	11	44	45	51	46	67	2.58	-1.5	7	6.1	w.	23	sw.	8	13	10	8	4.8	.0	.0
Parkersburg	637	77	84	29.34	30.02	+.03	64.2	+.4	93	22	78	33	11	50	42	55	48	61	3.37	.0	10	5.4	nw.	38	nw.	16	14	12	5	4.1	.0	.0
Pittsburgh [1]	842	39	54	29.12	30.01	+.02	62.0	-.4	90	22	74	33	11	50	35	53	45	59	3.52	+.3	10	10.4	nw.	38	nw.	16	12	12	7	4.8	.0	.0
Lower Lake Region							59.6	+2.2										63	2.20	-1.0										5.0		
Buffalo [2]	768	243	280	29.16	29.99	+.02	54.6	.0	75	6	62	37	10	48	23	50	43	62	1.11	-2.0	13	13.4	sw.	35	s.	7	10	10	11	5.6	.0	.0
Canton	448	10	61	29.45	29.92	------	56.8	+.6	84	21	69	28	3	44	36	50	43	62	1.73	-1.3	8	7.6	w.	27	e.	2	9	10	12	5.5	.0	.0
Ithaca	836	77	100	------	------	------	58.0	+.5	90	21	70	29	3	46	40	----	----	---	1.59	-1.8	12	7.5	nw.	25	n.	24	10	11	10	5.6	.0	.0
Oswego	335	71	85	29.59	29.95	-.02	55.4	+.2	87	28	64	36	12	46	33	49	43	65	1.17	-1.9	11	7.9	w.	21	nw.	24	12	11	8	5.2	.0	.0
Rochester [1]	523	5	69	29.41	29.97	.00	58.2	+1.1	89	21	70	32	3	46	35	51	44	62	1.22	-1.7	13	10.2	sw.	34	sw.	28	7	11	13	6.1	.0	.0
Syracuse [1]	506	5	51	29.31	29.96	-.02	57.8	+.1	90	21	70	30	3	45	45	52	45	63	2.90	-.1	13	9.2	sw.	35	nw.	24	9	9	13	6.1	.0	.0
Erie [2]	714	57	81	29.24	30.01	+.03	60.2	+3.4	84	21	68	39	3	52	23	53	48	69	2.04	-1.4	10	7.8	w.	23	sw.	27	15	8	8	4.3	.0	.0
Cleveland [2]	762	267	318	29.19	30.01	+.03	62.2	+4.3	89	21	71	38	10	54	25	53	46	59	2.41	-.7	9	13.4	sw.	40	nw.	16	14	10	7	4.1	.0	.0
Sandusky	629	5	67	------	------	------	63.6	+4.4	93	28	75	39	12	52	36	----	----	---	3.47	+.3	14	8.3	sw.	22	w.	16	15	7	9	4.2	.0	.0
Toledo [2]	628	79	87	29.33	30.01	+.04	64.0	+4.6	90	28	74	39	10	54	33	54	48	63	4.42	+.9	10	9.6	w.	25	s.	15	18	9	4	3.4	.0	.0
Fort Wayne [1]	856	69	84	29.10	30.01	------	62.2	+2.6	91	28	75	36	11	50	39	55	49	65	2.07	-1.8	8	8.3	sw.	34	nw.	15	9	13	9	5.2	.0	.0
Detroit [1]	730	5	78	29.23	30.01	+.04	62.4	+4.4	92	28	74	35	10	51	36	53	45	57	2.29	-.9	10	9.8	sw.	35	nw.	22	10	14	7	5.1	.0	.0
Upper Lake Region							57.4	+4.7										67	3.13	-0.1										5.5		
Alpena	609	5	89	29.32	29.99	+.02	56.0	+5.5	89	20	66	35	11	46	37	48	41	60	2.64	-.4	11	10.2	nw.	31	nw.	26	11	7	13	5.7	.0	.0
Escanaba	612	51	72	29.32	29.98	+.01	54.2	+4.6	77	20	62	32	11	46	28	49	45	74	3.45	+.5	11	11.1	s.	29	n.	9	10	9	12	5.8	.0	.0
Grand Rapids [2]	707	70	244	29.22	29.98	+.01	61.8	+3.8	88	28	73	35	10	51	29	53	47	65	3.27	-.2	11	10.8	sw.	37	sw.	26	15	7	9	4.3	.0	.0
Lansing [2]	878	5	90	29.07	30.01	------	60.0	+3.1	86	21	71	35	10	49	33	53	48	66	3.28	-.1	10	7.7	sw.	26	nw.	22	14	8	9	4.5	.0	.0
Marquette	734	44	73	29.16	29.97	.00	55.5	+6.5	93	19	65	32	11	46	36	48	42	65	2.97	.0	13	8.3	nw.	24	sw.	4	10	6	15	6.0	.0	.0
Sault Sainte Marie [2]	614	11	52	29.31	29.98	+.03	53.0	+4.0	83	20	63	30	10	43	36	46	40	69	2.79	-.2	14	7.3	se.	26	nw.	12	9	10	12	6.1	.0	.0
Chicago	673	7	131	29.29	30.01	+.05	62.4	+4.9	91	28	71	40	10	54	29	54	48	64	3.42	-.1	12	10.0	sw.	32	nw.	7	13	10	8	4.6	.0	.0
Green Bay	617	109	141	29.31	29.98	+.03	59.6	+4.7	86	26	70	35	10	50	30	52	45	63	3.77	+.2	11	10.7	s.	33	se.	14	10	8	13	5.6	.0	.0
Milwaukee [1]	681	33	66	29.27	30.00	+.04	58.6	+4.5	88	20	69	33	10	48	38	52	46	68	3.03	-.3	14	11.1	sw.	50	s.	14	9	14	8	5.4	.0	.0
Duluth	1,133	5	47	28.72	29.94	-.02	52.8	+5.5	85	19	62	32	10	43	34	47	42	72	2.67	-.6	14	12.2	ne.	31	ne.	28	6	10	15	6.7	.0	.0
North Dakota							58.6	+4.7										67	1.84	-0.5										6.2		
Moorhead, Minn. [2]	940	50	58	------	29.88	-.06	59.8	+4.7	90	18	71	31	9	48	----	----	----	---	1.35	-1.5	8	9.9	s.	27	s.	5	7	9	15	----	.0	.0
Bismarck [1]	1,677	4	41	28.11	29.88	-.04	59.6	+5.1	98	18	72	27	9	47	44	51	45	65	1.03	-1.3	11	13.8	nw.	49	nw.	6	9	5	17	6.4	.0	.0
Devils Lake	1,478	11	44	28.32	29.88	-.06	56.8	+4.2	89	25	67	30	8	47	35	50	45	72	2.15	+.1	15	10.1	s.	30	nw.	7	7	5	19	7.0	.7	.0
Lemmon, S. Dak	2,602	4	38	27.18	29.88	------	58.8	------	93	18	72	29	8	46	40	51	44	---	3.80	------	11	------	s.	------	------	---	9	9	13	----	.0	.0
Grand Forks	832	11	71	28.99	29.88	------	58.4	+4.7	90	18	71	26	9	46	41	52	47	---	1.72	------	10	------	nw.	------	------	---	6	8	17	----	T	.0
Williston	1,878	42	50	27.90	29.85	-.08	58.6	+4.6	90	25	70	30	8	48	38	50	42	63	2.81	+.8	12	8.5	se.	36	nw.	6	10	11	10	5.1	.2	.0
Upper Mississippi Valley							66.6	+5.0										65	3.63	-0.4										5.0		
Minneapolis-St. Paul, Minn. [1]	919	32	61	28.94	29.92	-.02	63.3	+5.6	89	26	74	39	17	52	35	55	49	65	2.91	-.8	13	11.3	s.	37	nw.	7	5	13	13	6.5	.0	.0
Springfield, Minn	1,025	4	42	29.83	29.92	------	64.4	------	94	14	76	35	10	52	37	56	50	---	7.63	------	10	------	s.	------	------	---	8	13	10	----	.0	.0
La Crosse [2]	714	11	48	29.19	29.95	+.01	64.1	+4.8	89	26	75	37	9	53	33	56	51	68	5.78	+2.0	11	5.4	s.	21	sw.	26	10	10	11	5.4	.0	.0
Madison [2]	974	70	78	28.95	29.99	+.03	62.2	+4.6	86	20	72	39	10	52	31	55	50	69	5.82	+2.0	13	7.4	s.	22	w.	22	12	12	7	5.2	.0	.0
Charles City	1,015	10	51	28.89	29.97	+.03	64.2	+6.4	89	26	76	38	10	52	35	56	50	67	7.60	+3.3	15	7.3	se.	23	sw.	26	12	14	5	4.5	.0	.0
Davenport [1]	606	66	161	29.33	29.99	+.04	67.2	+5.9	91	15	77	43	10	57	29	58	53	65	2.55	-1.4	11	9.3	sw.	27	nw.	6	7	17	7	5.2	.0	.0
Des Moines [1]	860	5	99	29.03	29.94	+.01	67.8	+6.5	91	15	79	43	10	57	32	58	52	64	2.13	-2.4	10	9.8	se.	28	sw.	26	10	14	7	5.3	.0	.0
Dubuque	699	60	79	29.23	29.97	+.02	65.6	+5.3	89	20	76	40	9	55	31	57	51	63	2.10	-2.1	11	6.1	s.	20	ne.	29	10	11	10	5.4	.0	.0
Keokuk	614	64	78	29.34	29.99	+.05	68.4	+4.6	90	30	78	42	9	68	27	----	----	---	2.28	-1.6	9	7.4	sw.	28	nw.	31	10	15	6	4.7	.0	.0
Cairo	358	87	93	29.64	30.02	+.06	71.0	+2.6	93	21	81	49	12	51	30	----	----	---	1.77	-1.9	7	7.6	s.	30	n.	16	7	17	7	5.4	.0	.0
Peoria [2]	609	11	45	29.35	30.00	+.04	66.8	+5.1	92	28	78	37	10	56	32	58	53	69	5.64	+1.6	9	5.4	s.	20	w.	7	14	14	3	3.8	.0	.0
Springfield, Ill. [2]	636	5	191	29.32	30.00	+.05	69.4	+6.2	94	21	80	44	10	59	33	58	53	67	3.03	-1.4	11	10.9	s.	29	s.	14	11	12	8	5.1	.0	.0
St. Louis [3]	568	179	303	29.40	30.00	+.05	69.0	+2.0	93	21	80	43	9	58	37	60	52	57	1.91	-2.4	9	11.6	sw.	38	sw.	14	18	7	6	3.9	.0	.0
Missouri Valley							67.9	+5.9										67	2.46	-1.6										5.7		
Columbia, Mo. [2]	784	6	66	29.16	29.98	+.04	70.0	+5.7	92	21	81	42	9	59	31	60	55	66	5.35	+.9	8	7.4	s.	21	nw.	31	11	17	3	4.5	.0	.0
Kansas City [1]	963	38	76	28.94	29.96	+.04	70.5	+5.7	91	14	81	45	9	60	30	61	55	65	3.18	-1.5	12	10.6	sw.	30	nw.	27	7	18	6	5.4	.0	.0
St. Joseph [2]	967	11	49	28.94	29.95	------	69.6	+5.4	93	14	80	44	9	59	30	61	58	76	3.57	-1.1	11	8.3	s.	30	nw.	6	11	16	4	4.6	.0	.0
Springfield, Mo. [1]	1,324	5	78	28.62	30.00	+.07	67.6	+6.1	88	31	78	43	9	57	30	60	56	72	2.09	-3.1	8	10.3	se.	34	w.	16	6	15	10	5.9	.0	.0
Topeka	987	65	87	28.91	29.95	------	70.4	+6.1	95	14	82	46	9	59	31	61	56	67	3.78	-.7	12	9.0	s.	36	nw.	16	3	20	8	6.1	.0	.0
Lincoln [2]	1,189	11	81	28.67	29.91	.00	68.4	+6.7	94	14	79	44	9	58	32	59	55	70	2.47	-1.6	11	9.7	s.	30	w.	7	6	12	13	6.2	.0	.0
Omaha [1]	1,105	31	44	28.77	29.94	+.02	68.0	+5.6	94	14	79	41	9	57	32	59	53	64	1.05	-2.7	13	10.4	s.	34	nw.	7	5	16	10	5.9	.0	.0
Valentine	2,598	46	54	27.21	29.89	-.01	63.4	+7.2	97	13	76	33	23	51	39	53	46	60	.60	-2.2	12	10.1	s.	33	s.	24	5	16	10	6.2	.0	.0
Sioux City [2]	1,138	64	106	28.72	29.92	.00	67.0	+6.4	95	14	78	40	9	56	35	58	52	64	1.97	-2.1	12	10.9	s.	35	sw.	18	3	15	13	6.3	.0	.0
Huron [1]	1,306	26	41	28.51	29.88	-.04	63.8	+7.4	93	18	76	32	9	51	38	55	48	62	.59	-2.4	7	14.8	s.	49	nw.	7	7	14	10	5.6	.0	.0
Northern Slope							56.8	+4.3										60	1.58	-0.7										6.0		
Billings [1]	3,570	18	39	26.24	29.85	------	59.3	------	90	24	72	38	8	46	39	48	39	56	2.00	------	12	10.1	sw.	49	n.	13	7	15	9	5.6	.0	.0
Havre	2,507	11	67	27.26	29.86	-.04	57.8	+4.4	93	24	71	29	8	44	48	47	36	52	1.82	-.2	11	9.4	w.	36	sw.	5	7	12	12	5.9	.0	.0
Helena [1]	4,124	5	35	25.74	29.91	-.02	54.6	+3.0	85	12	68	32	9	41	47	45	38	60	1.67	-.6	13	10.3	w.	42	w.	5	5	10	16	6.7	T	.0
Missoula [2]	3,263	80	91	26.58	29.94	------	55.8	+3.0	90	11	68	33	7	44	43	47	41	67	2.72	+.7	19	6.8	nw.	30	nw.	17	3	14	14	6.9	T	.0
Kalispell	2,973	48	56	26.88	29.91	+.03	53.4	+2.0	81	24	64	30	9	42	40	45	38	62	1.75	+.3	18	6.7	w.	22	s.	17	4	13	14	6.9	.0	.0
Miles City [2]	2,371	48	55	27.39	29.85	-.06	61.4	+4.1	94	12	74	33	8	49	39	50	42	58	1.94	-.3	10	7.2	nw.	39	nw.	13	7	16	8	5.5	.0	.0
Rapid City [2]	3,259	50	58	26.55	29.87	-.06	61.0	+7.0	91	13	73	38	23	49	40	50	43	50	1.34	-2.2	9	8.5	s.	34	nw.	6	11	17	3	4.5	T	.0
Cheyenne [1]	6,094	5	39	23.98	29.87	+.02	54.3	+4.0	86	12	67	32	7	42	38	45	39	64	.68	-1.8	8	11.1	nw.	43	n.	19	3	13	15	7.0	T	.0
Lander	5,352	60	68	24.62	29.86	-.02	55.8	+4.0	84	12	70	31	7	42	41	44	34	49	.98	-1.3	4	6.7	sw.	26	sw.	28	7	17	7	5.5	2.6	.0
Sheridan [4]	3,790	6	42	26.03	29.87	------	56.6	------	93	12	71	33	20	42	48	47	39	59	1.52	-1.1	10	8.9	nw.	38	se.	3	5	13	13	6.2	T	.0
Yellowstone Park	6,241	12	46	23.86	29.98	+.07	48.8	+4.2	77	12	61	27	6	37	40	40	33	61	1.40	-.4	12	8.6	sw.	32	sw.	5	8	7	16	6.3	T	.0
North Platte [2]	2,821	11	51	27.00	29.88	.00	64.6	+5.9	91	18	77	39	7	53	33	55	50	68	1.55	-1.2	16	8.6	s.	27	ne.	22	9	14	8	5.2	.0	.0

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max.+mean min.÷2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01 inch or more	Wind: Average hourly velocity	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0-10	In.	In.
Middle Slope							**66.4**	**+3.9**										68	**2.93**	**−0.4**										**5.7**		
Denver [1]	5,292	106	113	24.70	29.86	+0.02	61.0	+4.8	89	13	72	38	19	50	34	48	39	58	2.18	.0	8	8.1	s.	31	nw.	9	7	19	5	4.9	0.0	0.0
Pueblo [1]	4,690	5	36	25.26	29.86	+.03	61.8	+2.6	94	13	75	42	5	48	43	50	42	60	1.74	+.1	10	9.1	se.	33	n.	22	8	14	9	5.5	.0	.0
Concordia	1,392	50	58	28.48	29.92	+.01	67.8	+4.6	94	14	78	44	9	57	30	60	54	67	1.81	−2.4	11	8.2	s.	27	n.	16	5	14	12	6.0	.0	.0
Dodge City	2,509	10	86	27.34	29.89	+.02	66.8	+3.3	97	14	77	49	10	56	38	59	55	72	3.76	+.9	15	12.2	s.	40	s.	27	8	11	12	6.0	.0	.0
Wichita [1]	1,358	6	64	28.53	29.94	+.04	69.1	+4.0	92	31	79	47	10	60	27	62	58	74	2.89	−1.6	8	14.8	s.	36	s.	13	8	14	9	5.5	.0	.0
Oklahoma City [1]	1,214	10	47	28.68	29.94	+.05	71.6	+3.9	90	31	81	53	12	62	29	64	61	76	5.22	+.3	12	9.2	s.	23	sw.	14	5	11	15	6.4	.0	.0
Southern Slope							**70.3**	**−0.4**										**72**	**5.39**	**+2.7**										**5.9**		
Abilene [1]	1,738	10	56	28.12	29.89	+.02	73.8	+1.8	94	30	84	51	3	63	33	65	62	77	6.47	+2.5	9	10.1	s.	37	nw	20	10	11	10	5.7	.0	.0
Amarillo [2]	3,676	10	49	26.23	29.89	+.05	64.1	.0	90	13	75	46	5	53	33	58	55	79	7.47	+4.7	14	14.7	s.	46	s.	2	7	13	11	6.2	.0	.0
Del Rio	960	63	71	28.89	29.85	.00	76.2	−.8	92	7	85	54	3	68	28	67	63	68	1.21	−1.7	4	10.7	se.	31	se.	20	5	8	18	6.5	.0	.0
Roswell	3,566	75	85	26.31	29.86	+.04	67.0	−2.4	94	9	78	48	2	56	39	57	50	64	6.42	+5.3	15	8.5	s.	29	se.	28	13	6	12	5.3	.0	.0
Southern Plateau							**66.9**	**+1.9**										**46**	**1.15**	**+0.7**										**4.3**		
El Paso [2]	3,778	82	101	26.10	29.78	.00	73.7	+2.2	96	9	86	49	3	61	32	55	42	42	1.23	+.9	6	9.1	w.	28	nw.	1	15	14	2	3.8	.0	.0
Albuquerque [1]	4,972	5	34	25.01	29.81	......	63.8	+.5	88	13	77	40	20	51	37	50	38	48	3.07	+2.5	10	10.2	se.	40	e.	23	8	10	13	5.9	.0	.0
Santa Fe [2]	7,013	38	53	23.24	29.87	+.06	57.0	+1.3	78	13	68	38	20	46	31	46	36	56	2.20	+.9	7	6.4	e.	27	s.	28	8	9	14	5.9	.0	.0
Flagstaff	6,907	10	59	......	......	......	51.3	+.6	76	11	66	29	29	37	41	41	33	55	.70	−.4	9	10.0	sw.	38	s.	18	11	14	6	4.9	T	.0
Phoenix [2]	1,107	39	87	28.67	29.80	+.02	76.4	+1.4	102	8	91	52	2	62	41	57	43	41	.76	+.7	3	5.8	e.	24	w.	18	12	15	4	4.3	.0	.0
Yuma	142	9	54	29.66	29.80	+.01	80.2	+4.0	107	7	96	57	1	65	38	60	44	33	.00	.0	0	6.1	w.	24	nw.	19	27	4	0	1.1	.0	.0
Independence	3,957	5	26	25.90	29.88	+.04	66.0	+3.0	89	2.	81	41	1	51	36	48	30	......	.12	.0	1	......	nw.	......	......	......	17	11	3	......	.0	.0
Middle Plateau							**59.2**	**+3.2**										**52**	**0.97**	**−0.1**										**5.3**		
Reno [2]	4,527	61	76	25.44	29.95	+.04	56.6	+2.4	87	22	70	32	18	44	40	44	35	57	.16	−.5	4	7.6	w.	30	sw.	11	9	18	4	4.7	T	.0
Tonopah	6,090	12	20	24.02	29.89	......	57.5	......	80	10	70	26	19	45	36	44	31	......	.80	......	5	......	nw.	......	......	......	8	20	3	......	T	.0
Winnemucca	4,339	5	56	25.58	29.91	.00	57.8	+3.9	92	11	73	32	19	43	46	46	35	51	1.77	+.9	12	8.9	sw.	34	sw.	5	5	9	17	6.5	T	.0
Modena	5,473	10	46	......	......	......	56.0	+2.5	84	10	72	29	19	40	41	......	......	......	.41	−.4	7	10.8	w.	43	sw.	18	14	11	6	4.0	T	.0
Salt Lake City [2]	4,357	86	210	25.54	29.86	.00	62.1	+4.7	90	12	74	36	18	50	36	48	38	52	1.46	−.5	12	9.0	nw.	36	w.	18	12	10	9	5.1	T	.0
Grand Junction	4,602	60	68	25.31	29.84	+.01	63.5	+2.4	91	12	76	39	20	51	33	49	37	47	1.03	+.2	8	7.0	se.	33	s.	15	5	15	11	6.0	.0	.0
Northern Plateau							**57.0**	**+0.6**										**61**	**2.13**	**+0.7**										**6.6**		
Baker [2]	3,471	36	54	26.40	29.95	−.01	53.0	+1.3	87	23	65	32	18	40	42	46	41	71	1.06	−.5	12	5.8	s.	26	sw.	12	5	9	17	6.7	T	.0
Boise [1]	2,739	5	49	27.10	29.91	−.03	58.4	......	93	11	71	33	19	46	40	49	42	60	1.65	......	17	9.8	nw.	45	sw.	12	6	9	16	6.3	.0	.0
Pocatello [1]	4,478	5	31	25.42	29.90	+.01	55.8	......	87	11	69	31	19	43	47	46	38	58	1.78	+.3	12	10.6	sw.	35	s.	17	8	10	13	6.0	T	.0
Spokane [1]	1,929	27	42	27.90	29.93	−.03	55.7	+.2	89	23	67	34	19	45	43	48	42	65	3.18	+1.8	17	7.9	s.	29	s.	11	5	6	20	7.2	.0	.0
Walla Walla	991	57	65	28.88	29.95	−.01	60.0	+.4	90	23	70	41	18	50	34	......	......	......	4.09	+2.5	16	6.5	s.	20	w.	17	6	5	20	6.9	.0	.0
Yakima	1,076	58	67	28.79	29.94	......	59.4	+.4	91	24	71	38	6	48	37	48	38	52	.56	−.7	7	7.0	nw.	30	sw.	4	5	12	14	6.5	.0	.0
North Pacific Coast Region							**56.9**	**+2.6**										**74**	**3.70**	**+1.4**										**7.0**		
North Head	211	5	56	29.77	30.00	−.03	54.8	+3.9	82	22	60	46	3	50	26	50	47	78	3.90	+1.0	16	15.1	n.	51	s.	17	4	10	17	7.1	.0	.0
Seattle [2]	125	90	321	29.85	29.98	−.03	57.6	+3.1	80	22	65	43	18	50	28	50	45	70	3.36	+1.5	17	10.8	s.	41	sw.	11	5	8	18	7.2	.0	.0
Tacoma	194	172	201	29.79	29.99	−.03	56.2	+2.1	76	10	64	42	9	49	28	......	......	......	2.87	+.8	15	10.4	sw.	36	sw.	11	5	4	22	7.3	.0	.0
Tatoosh Island	86	9	61	29.88	29.98	−.03	52.2	+2.6	69	11	56	44	5	48	15	49	47	82	5.93	+1.9	18	15.0	s.	50	s.	11	6	12	13	6.5	.0	.0
Medford [1]	1,329	29	58	28.58	29.98	......	59.4	+1.7	100	22	72	34	19	46	47	51	44	66	2.15	+.9	14	......	nw.	......	......	......	5	7	19	7.1	.0	.0
Portland, Oreg. [2]	154	68	106	29.83	30.00	−.03	59.0	+2.1	89	23	68	43	19	50	32	52	48	75	4.97	+2.8	19	6.0	nw.	26	sw.	11	5	8	18	7.2	.0	.0
Roseburg	510	45	76	29.46	30.01	−.02	58.8	+2.8	92	22	70	36	19	48	40	52	46	70	2.69	+.8	15	4.5	n.	26	sw.	17	5	11	15	6.7	.0	.0
Middle Pacific Coast Region							**61.8**	**+2.2**										**69**	**2.63**	**+1.4**										**6.2**		
Eureka	60	72	88	29.99	30.05	.00	55.8	+3.8	83	10	61	42	18	50	30	52	50	82	3.61	+1.8	17	7.4	n.	34	sw.	11	4	5	22	7.6	.0	.0
Redding [1]	722	20	34	29.18	29.95	......	65.1	−1.3	102	22	75	46	18	55	35	55	46	57	4.38	+2.8	13	7.7	nw.	34	nw.	17	7	9	15	6.6	.0	.0
Sacramento [2]	66	92	115	29.89	29.96	+.02	65.2	+1.9	93	21	76	47	18	54	35	56	50	65	1.35	+.6	5	8.3	s.	30	nw.	19	12	13	6	4.4	.0	.0
San Francisco	155	112	132	29.83	30.00	+.01	61.2	+4.4	89	10	67	50	18	56	25	55	50	72	1.18	+.4	7	9.6	w.	27	s.	12	8	9	14	6.0	.0	.0
South Pacific Coast Region							**68.3**	**+4.9**										**61**	***T***	**−0.4**										**3.6**		
Fresno [1]	327	5	35	29.60	29.94	+.02	69.8	+2.7	97	22	84	47	18	56	39	57	46	50	T	−.4	0	8.5	nw.	28	nw.	18	17	12	2	3.1	.0	.0
Los Angeles	338	223	250	29.57	29.93	−.02	67.9	+5.7	97	7	78	47	1	58	32	58	52	62	T	−.4	0	6.8	w.	27	nw.	5	15	13	3	3.7	.0	.0
San Diego [1]	87	20	55	29.84	29.94	−.01	67.2	+6.4	86	25	75	50	1	59	28	60	55	70	T	−.4	0	6.9	w.	18	nw.	19	14	11	6	4.1	.0	.0
West Indies																																
San Juan, P. R.	82	10	54	29.87	29.95	......	79.6	+1.0	91	19	84	69	6	75	14	......	......	......	7.67	+2.4	16	10.8	e.	26	ne.	7	1	18	12	6.3	.0	.0
Panama Canal																																
Balboa Heights	118	6	92	......	[4]29.78	−.04	82.6	+1.9	94	15	89	73	11	76	18	......	......	[3]89	9.03	+1.1	16	5.3	nw.	22	se.	25	0	20	11	6.8	.0	.0
Cristobal	36	6	97	......	[4]29.80	−.04	83.8	+3.1	94	1	88	74	25	79	15	78	77	[3]84	8.97	−3.6	18	7.3	n.	20	n.	16	2	4	25	8.6	.0	.0
Alaska																																
Fairbanks	454	11	87	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Juneau	80	96	116	......	[4]29.91	......	49.2	+1.4	78	31	56	37	10	42	......	......	......	68	3.80	−1.4	13	6.4	s.	25	e.	18	9	2	20	......	.0	.0
Nome	22	5	59	......	[4]29.81	......	34.8	+.5	56	15	37	22	22	36	......	......	......	85	.23	−.4	6	8.6	e.	31	s.	29	4	8	19	......	.3	.0
Hawaiian Islands																																
Honolulu	38	86	100	29.96	30.00	......	74.8	.0	82	19	79	67	23	70	15	67	63	69	.37	−1.4	9	10.7	e.	29	ne.	25	11	11	9	5.1	.0	.0

LATE REPORT FOR APRIL 1941

Moorhead, Minn. [2]	940	50	58	28.95	29.98	−.01	47.0	+6.4	77	27	56	20	2	38	37	43	40	80	3.51	+1.3	20	9.2	n.	25	se.	11	2	8	20	7.9	.5	.0

[1] Data are airport records.
[2] Barometric and hygrometric data from airport, other data from city office records.
[3] Observations taken bihourly.
[4] Pressure not reduced to mean of 24 hours.
[5] Barometric data from airport records, other data from city office records.
[6] Wind, and clear, partly cloudy, and cloudy data from city office records; other data from airport.

NOTE.—Except as indicated by notes 1, 2, 5 and 6, data in table are city office records.

SEVERE LOCAL STORMS, APRIL 1941

[Compiled by Mary O. Souder]

[The table herewith contains such data as has been received concerning severe local storms that occurred during the month. A revised list of tornadoes will appear in the United States Meteorological Yearbook]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Phillipsburg, Kans., 10 miles south.	2	4 p. m.	8	0	$300	Tornado	Two funnel clouds seen. An oil derrick wrecked and several fences torn up; path 440 yards in length.
Tyler, Tex.	2	4-6 p. m.	[1] 6		125,000	Heavy hail	Property damaged. Loss to crops unknown.
Jefferson County, Kans.	2	4:15 p. m.	[1] 6		1,000	Hail	Storm occurred from Valley Falls eastward. Principal damage to roofs, windows and car tops; path 4 miles long.
Wortham, Tex.	2	7:40 p. m.	100	0	15,000	Tornado	Property damaged; 3 persons injured; no crop loss.
Vero Beach, Fla., vicinity of.	3	9 a. m.				Wind	Plane severely damaged and all 16 occupants injured.
Topeka, Kans., 10 miles northwest.	3	4-5 p. m.			5,000	Hail and rain	Most damage resulted from heavy rain washing fields and highways.
Perry County, Ark., and vicinity.	3					Hail	Moderate damage to roofs and gardens.
Fort Pierce, Fla.	3				50,000	do	Loss in citrus and vegetables.
Waverly, Lake Wales, Lake Alfred and Winter Haven, Fla.	3				1,000,000	do	Severe loss in citrus; some light roofs damaged; some cloth automobile tops pierced.
Orangeburg, S. C., and vicinity.	4				2,000	Wind	Trees uprooted; buildings unroofed and windows broken.
West Palm Beach, Fla., vicinity of.	5	A. m.			5,000	do	Airplane overturned; windows broken; roofs damaged; signs and poles blown down; garage blown over.
Scottsbluff, Nebr., vicinity of.	5	7 p. m.	50	0	1,000	Tornado	A small house wrecked; 4 persons injured.
Max, Nebr.	5	10:30 p. m.	100	0	2,000	do	Barns and small buildings on 3 farms northeast of Max damaged.
Fort Lauderdale, Fla.	7	9:40 p. m.			2,200	Wind and hail	One plane turned over and 3 others damaged. Wind velocity at the Airport estimated as 75 miles per hour in gusts.
Orland, Calif.	9	3 p. m.	50	0		Tornado	Considerable damage to trees and buildings. 1 person slightly injured; path 6 to 8 miles long; damage not estimated.
Minnesota, extreme northwestern Counties.	9-11				27,000	Snow and rain	The melting of a deep snow layer near the close of March and during the first part of April, together with frequent light to moderately heavy rains caused streams to overflow. Highways, roads, and lowlands inundated; basements, houses, and buildings flooded.
Greeley, Wallace, Sherman and Cheyenne Counties, Kans.	12	9-11 p. m.	550	0	100,000	Tornado and hail	The tornado extended from the Greeley County line northeastward through Sharon Springs to slightly west of Edson, then almost due north passing just west of Bird City to Benkleman, Nebr. 5 persons were injured, 20 houses wrecked, 43 Union Pacific box cars blown from the track. Power lines, fences, and occasional farm buildings damaged along the path in Kansas. Estimate given is for damage occurring in Kansas, chiefly at Sharon Springs. Path 150 miles long.
Benkleman, Nebr.	12	9:45 p. m.	100	0	20,000	Tornado	Eight buildings at county fair ground and 4 residences across the street destroyed. 14 persons injured, 2 seriously. Storm entered from Kansas.
Ione, N. Mex.	13	Midnight-1 a. m.			500	Wind	Damage to farm buildings.
New Ulm, Minn., and vicinity.	13	2:40 p. m.			20,000	Thunderstorm	Barn demolished, several windmills blown down, houses and barns damaged, garage and small buildings moved from their foundations, number of trees uprooted, 1 person injured, and path 150 miles long.
Adams, Union, Polk and Marshall Counties, Iowa.	13	3-4:30 p. m.		1	8,500	Wind	Near Van Cleve, in Marshall County, a child of 5 years, was killed when a gust of wind dashed him against a chicken house, fracturing his skull.
Deerbrook, Wis.	13	4 p. m.	167	0	12,000	Tornado	Funnel cloud observed. Property damaged; 11 cattle killed; path 6 miles long.
Hand County, S. Dak., southern portion.	13	7 p. m.	200		5,000	Wind	High southwesterly tornadic wind caused the destruction of several farm buildings.
Montrose, S. Dak., vicinity of.	13		880		500	do	Barn destroyed; chickens killed.
Plover, Wis.	14	2 p. m.		0	4,000	Tornado	Damage to 7 farms.
Rotan, Tex.	15	2 a. m.	440-880		25,000	Straight-line wind	Property damaged.
Abilene, Tex.	15	3 a. m.	33	0	100	Tornado	Barn damaged.
Hillsboro, Tex.	15	7:45-8:05 a. m., 8:45-9 p. m.	[1] 5		95,000	Hail	$20,000 loss to crops, mostly orchards and corn; $75,000 to buildings and roofs.
Saint Joe, Tex.	17	3:52 p. m.	200	0	2,500	Tornado	Three houses and a number of outbuildings damaged; no estimate of crop loss given.
Brown County, Kans.	17	4-6 p. m.	[1] 8		3,000	Hail, wind, and rain.	Hail as large as hulled walnuts and hen eggs fell over most of the path from the southwestern corner of Brown County to north of Robinson. Gardens, fruit trees, and roofs damaged by hail. Heavy rains washed fields, damaged bridges and highways and washed out a section of Grand Island track near Robinson. Path 20 miles long.
Red Oak, Stanton, and Villison, Iowa.	17	4:15 p. m.	[1] 15		15,000	Hail and heavy rain.	Property damaged; loss to crops.
Iowa County, Iowa [2]	17	4:30 p. m.	[1] 40	0	50,000	Tornado, hail, and rain.	Property damaged; 3 persons injured.
Hico, Tex.	17	4:30 p. m.	[1] 2		3,500	Heavy hail	Loss to crops, $2,500; damage to fences and buildings.
Benton County, Iowa	17	5 p. m.		0	12,000	Tornado, rain and hail.	In Norway about 4 inches of rain fell in an hour. Several roofs damaged and windows broken; oats and small grain washed out. The damage was mostly in the extreme southeastern portion of the county.
Dubuque County, Iowa	17	5:45-9 p. m.			8,000	Heavy rain, electrical.	Fields washed; streets and roads damaged; 2 barns burned after being struck by lightning.
Swisher, Iowa, vicinity of	17	6 p. m.			595	Wind	Electric railroad poles down; farmhouse overturned.
Springfield, Spring Grove, Walker, and Cedar Rapids, Iowa.	17	6:30 p. m.		0	17,500	Tornado, rain, and hail.	Storm continued movement toward the northeast. Indian Creek flooded at Cedar Rapids. Paving damaged.
Monticello, Langworthy, Anamosa, and Martelle, Iowa.	17	7:15 p. m.		1	35,000	do	The tornado continued along a path until in vicinity of Langworthy and Monticello, where twisting action disappeared. Power company property damaged at Anamosa, leaving this and other nearby towns without power. Man killed.
Hamilton, Tama, Keokuk, and Worth Counties, Iowa.	17	P. m.			10,000	Hail, rain, and wind.	Property damaged and railroad grades flooded by heavy rain.
Villa Nova, Iowa	17	do			25,000	Electrical	Church burned.
Berryville, Ark.	18	A. m.				Wind, electrical	Several buildings destroyed.
Locust Grove, Okla.	18	6:30 p. m.	880		2,100	Wind and rain	Loss to crops, $100; property damage, $2,000.
Sayre, Okla., 6 miles northeast.	18	11 p. m.	440	0	12,500	Torando	Property damaged; path 2 miles long.
War Eagle, 4 miles southeast, to Grandview, Ark.	18		220-440	0		do	Stone residence and store completely wrecked; several brooder houses demolished and 2,700 chickens killed. Man seriously injured when his home was damaged. Path 25 feet long.
Frederick and Tipton, Okla.	19	12:40 a. m.	[1] 6		25,000	Hail and wind	Loss of grain crops, alfalfa, and fruit, $15,000; property damage, $10,000; path 15 miles long.
Cache, Okla.	19	1:10 a. m.	880		1,200	Tornadic wind	Property damage, $1,000; loss to crops, principally orchards, $200; path 5 miles long.
Corwin to Anthony, Kans.	19	2 a. m.	[1] 5		1,500	Hail	Principal damage to gardens; path 20 miles long.
Clearwater to Wichita, Kans., and vicinities.	19	2-3 a. m.			800	Wind and hail	Hail damaged gardens and blooming fruit trees. Trees, outbuildings, and several residences damaged by violent wind with tornadic characteristics. Path narrow and 25 miles long.

Footnotes at end of table.

SEVERE LOCAL STORMS, APRIL 1941—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Tulsa, Okla	19	5 a. m.	13	0	$300	Tornado	Trees blown down and a garage wrecked; path 67 yards long.
St. Joseph County, Ind	19	3:40 p. m.			5,000	Wind	Two barns blown down.
Footville, Wis., south of	19	8:30 p. m.	100	0	10,000	Tornado	The funnel cloud lifted and dipped, skipping some farms in its path.
Rock County, Wis., western portion.	19	8:30-8:45 p. m.	[1] 6-8		25,000	Wind	Property damaged.
Huntington and Wells Counties, Ind.	19-20				1,000	do	Buildings damaged.
Wisconsin, east-central and southwestern counties.	19-20				50,000	Sleet, snow, and wind.	Hundreds of poles and wires down, mostly as a result of heavy, moist snow that froze and clung to wires, together with high winds. Ice began to freeze about 4 a. m., of the 20th, and remained on wires from 3 to 4 hours. Communication and electric service disrupted. Silo blown down and some wind damage to property.
Des Moines, Iowa	20				500	Wind	Airplanes staked out at the airport damaged.
Livingston County, Mich	22			0	100,000	Tornado	The first sign of destructive force exerted by the storm was the complete leveling of a barn in the southwestern end of the storm's path, about 5 miles north of Gregory. From this spot the trail could be plainly traced in a northeastern direction crossing U. S. Highway 16, about a mile west of Howell and apparently terminating about 5 miles east of Oak Grove at the intersection of the Oak-Grove-Argentine roads. Over the first half of the path, many of the buildings were completely demolished. In the latter part of the wake, structures were only partially destroyed and twisted. About 25 separate farms were struck, some being a total loss, while others had only minor damage. The wreckage from those hardest hit was scattered in a northeasterly direction for several hundred yards, with tin roofs being found as far away as a mile. Trees as large as 2 feet were twisted off 10 to 15 feet above the ground and lay in all directions. Many roads were temporarily blocked by fallen trees and telegraph poles. Few persons were injured, none seriously, and some cattle and poultry lost.
Anthony, N. Mex	26	7 p. m.			1,000	Heavy hail	Loss to crops.
Munday, Tex	30	9:30-11 p. m.	[1] 3		30,000	do	$20,000 loss to wheat, oats, and barley; $10,000 damage to buildings.

[1] Miles instead of yards.

[2] See Climatological Data, June 1941, for detailed report of tornadoes in Iowa, April 1941.

SOLAR RADIATION AND SUNSPOT DATA FOR MAY 1941

SOLAR RADIATION OBSERVATIONS

By HELEN CULLINANE

Measurements of solar radiant energy received at the surface of the earth are made at 9 stations maintained by the Weather Bureau and at 12 cooperating stations maintained by other institutions. The intensity of the total radiation from sun and sky on a horizontal surface is continuously recorded (from sunrise to sunset) at all these stations by self-registering instruments; pyrheliometric measurements of the intensity of direct solar radiation at normal incidence are made at frequent intervals on clear days at three Weather Bureau stations (Madison, Wis.; Lincoln, Nebr., and Albuquerque, N. Mex.) and at the Blue Hill Observatory at Harvard University. Occasional observations of sky polarization are taken at the Weather Bureau station at Madison and at Blue Hill Observatory.

The geographic coordinates of the stations, and descriptions of the instrumental equipment, station exposures, and methods of observation, together with summaries of the data obtained, up to the end of 1936, will be found in the MONTHLY WEATHER REVIEW, December 1937, pp. 415 to 441; further descriptions of instruments and methods are given in Weather Bureau Circular Q.

Table 1 contains the measurements of the intensity of direct solar radiation at normal incidence, with means and their departures from normal (means based on less than 3 values are in parentheses). At Lincoln, Madison, Albuquerque, and Blue Hill the observations are obtained with a recording thermopile, checked by observations with a Smithsonian silver-disk pyrheliometer at Blue Hill. The table also gives vapor pressures at 7:30 a. m. and at 1:30 p. m. (75th meridian time).

Table 2 contains the average amounts of radiation received daily on a horizontal surface from both sun and sky during each week, their departures from normal and the accumulated departures since the beginning of the year. The values at most of the stations are obtained from the records of the Eppley pyrheliometer recording on either a microammeter or a potentiometer.

Total solar and sky radiation during May was excessive at most stations, but somewhat below normal at Fairbanks, Blue Hill, and Friday Harbor.

Radiation at normal incidence was somewhat below normal at Madison, but very irregular at Blue Hill.

Polarization observations made at Madison on 9 days gave a mean of 55 percent, 1 percent below normal, with a maximum of 66, 2 percent above the normal maximum for the month.

TABLE 1.—*Solar radiation intensities during April 1941*

[Gram-calories per minute per square centimeter of normal surface]

Blue Hill Observatory

Date	Sun's zenith distance										
	7:30 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	1:30 p. m.
	75th mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Apr. 3	3.5						1.18	0.91	0.69	0.55	3.0
Apr. 4	3.6	0.83	0.93								4.4
Apr. 8	2.9	.94	1.04	1.14	1.22	1.40	1.20				4.2
Apr. 9	3.8	.94	1.04	1.14	1.25	1.42					3.8
Apr. 10	3.6	.69	.79	.90			1.16	1.00	.89		3.5
Apr. 11	3.5					1.36	1.15	.98	.84	.72	5.4
Apr. 12	5.2	.78	.88	1.00	1.15		.96	.72	.63	.55	3.8
Apr. 17	6.8						1.00	.74	.51	.35	6.8
Apr. 18	6.5	.77	.87	.99	1.16	1.34	1.13	.91	.80	.69	5.8
Apr. 19	6.3					1.29	1.10	.92	.79	.66	7.1
Apr. 20	10.7						.81	.69	.57	.45	10.7
Apr. 21	6.1								.87	.77	4.0
Apr. 22	3.6	.90	1.00	1.13	1.26	1.48	1.24	1.06	.94	.84	2.8
Apr. 23	2.5	.88	.98	1.08	1.23						3.2
Apr. 25	5.0	.77	.86	.94			1.10	.86	.71	.62	6.1
Apr. 29	3.5	.79	.90								4.2
Apr. 30	6.1	.58	.69	.83	.99	1.24					4.8
Means		**.81**	**.91**	**1.02**	**1.18**	**1.36**	**1.09**	**.88**	**.75**	**.62**	
Departures		**−.03**	**−.03**	**−.06**	**−.02**	**−.03**	**−.03**	**−.09**	**−.10**	**−.07**	

*Extrapolated.

Solar radiation intensities during May 1941

Blue Hill Observatory

Date	7:30 a. m. 75th mer. time	Sun's zenith distance 78.7° Air mass A. M. 5.0	75.7° 4.0	70.7° 3.0	60.0° 2.0	0.0° *1.0	60.0° P. M. 2.0	70.7° 3.0	75.7° 4.0	78.7° 5.0	1:30 p. m. Local mean solar time
	e										e
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
May 6	6.3	0.68	0.83	1.00	1.22						4.4
May 12	4.2				1.19	1.38					3.3
May 13	4.4	.73	.85	.98	1.10						5.0
May 14	6.5						0.96	0.87			6.1
May 15	6.5				.79						4.2
May 16	5.4	.77	.87	1.00	1.15	1.44		.82	.68	.57	4.8
May 18	5.4					1.54	1.27	1.13	1.00	.90	3.6
May 19	4.2	.87	.98	.96	1.27	1.47					3.2
May 20	5.8	.75	.84	.96	1.15	1.41	1.15				6.8
May 21	7.4			.84	.96		.89	.67	.52	.42	9.9
May 30	5.4						1.04	.83	.75	.65	4.0
May 31	5.6	.77	.87	1.02	1.20						5.0
Means		.76	.87	.98	1.11	1.45	1.06	.86	.72	.62	
Departures		+.06	0	−.05	0	+.09	−.03	−.04	−.04	−.06	

Madison, Wis.

Date	7:30 a. m. 75th mer. time	Sun's zenith distance 78.7° Air mass A. M. 5.0	75.7° 4.0	70.7° 3.0	60.0° 2.0	0.0° *1.0	60.0° P. M. 2.0	70.7° 3.0	75.7° 4.0	78.7° 5.0	1:30 p. m. Local mean solar time
	e										e
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
May 5	8.8	0.38	0.44	0.55	0.81	1.19					10.6
May 7	8.8	.64	.77	.84	1.08	1.38					7.9
May 10	4.2	.73	.81	.95	1.18	1.50					5.4
May 13	7.0	.75	.84	.99	1.15	1.34					5.6
May 17	5.6	.80	.95	1.11	1.28	1.47					5.8
May 19	9.1				.86						9.8
May 20	11.0	.44	.65	.91							15.1
May 23	6.8	.40	.58	.76	1.01	1.31					5.8
May 24	6.5	.74	.88	1.03	1.22	1.49					5.0
May 26	8.8	.33	.44	.59	.86	1.33					13.6
May 28	15.6	.41	.53	.66	.86	1.32					18.6
Means		.56	.69	.84	1.03	1.37					
Departures		−.04	−.09	−.13	−.08	0					

*Extrapolated.

TABLE 2.—*Average daily totals of solar radiation (direct+diffuse) received on a horizontal surface*

[Gram-calories per square centimeter]

Week beginning—	Washington	Madison	Lincoln	Chicago	New York	Fresno	Cambridge	Fairbanks	San Juan	La Jolla	Newport	New Orleans	Riverside	Blue Hill	Albuquerque	Friday Harbor	Ithaca
	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
April 30	592	499	437	488	576	585	384	404	312	478	433	308	404	388	540	425	
May 7	539	559	537	540	495	659	438	441	556	601	453	635	616	408	741	559	478
May 14	562	557	549	538	571	687	622	248	469	535	603	614	588	618	740	396	488
May 21	588	600	589	631	597	665	446	444	406	597	514	460	595	436	552	665	482
May 28	320	400	487	388	488	708	460	536	488	581	506	277	567	445	657	558	492
DEPARTURES FROM WEEKLY NORMALS																	
April 30	+118	+52	−42	+80	+157	−31	−20	−2		−108	+3	−93	−133	−78		−101	
May 7	+76	+104	+75	+108	+85	+23	−32	−16		+13	−33	+196	+56	−86		+4	+49
May 14	+84	+78	+30	+97	+118	+34	+90	−198		+4	+60	+175	+60	+91		−135	+43
May 21	+87	+102	+31	+156	+156	+3	−48	−5		+82	−20	+35	+37	−40		+38	
May 28	−191	−95	−44	−92	+18	+33	0	+72		+17	−15	−188	+10	−102		0	+30
ACCUMULATED DEPARTURES ON JUNE 3, 1941																	
	+3,066	+3,059	−5,179	+6,160	+14,427	−3,437	−112	−2,331		−1,876	−21	+3,710	−3,766	−672		+3,892	

CORRECTIONS IN TABLE 2 FOR JANUARY, FEBRUARY, MARCH, AND APRIL 1941

New factors for the instruments at Chicago, Ill., and Fresno, Calif., make the following changes necessary in table 2:

Week beginning—	Chicago, Ill. cal.	Chicago, Ill. Departure	Fresno, Calif. cal.	Fresno, Calif. Departure
Jan. 1	115	+27	104	−38
Jan. 8	81	−1	167	+6
Jan. 15	100	−2	179	+1
Jan. 22	51	−71	169	−38
Jan. 29	129	+8	150	−32
Feb. 5	143	+2	163	−89
Feb. 12	151	−1	238	−44
Feb. 19	282	+94	248	0
Feb. 26	203	−13	142	−213
Mar. 5	275	+53	439	+44
Mar. 12	317	+72	343	−64
Mar. 19	378	+111	499	+55
Mar. 26	279	+17	401	−55
Apr. 2	299	−3	468	−36
Apr. 9	420	+66	417	−132
Apr. 16	312	−34	635	+50
Apr. 23	599	+206	594	+32

POSITIONS, AREAS, AND COUNTS OF SUN SPOTS FOR MAY 1941

[Communicated by Capt. J. F. Hellweg, U. S. Navy (Ret.), Superintendent, U. S. Naval Observatory.] All measurements and spot counts were made at the Naval Observatory from plates taken at the observatories indicated. Difference in longitude is measured from the central meridian, positive toward the west. Latitude is positive toward the north. Areas are corrected for foreshortening and expressed in millionths of Sun's hemisphere. For each day, under longitude, latitude, area of spot or group, and spot count, are included assumed longitude of center of the disk, assumed latitude of center of the disk, total area of spots and groups, and total spot count

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1941	h. m.		°	°	°	°				
May 1	10 55	8079	−70	168	+17	73	121	3	VG	U.S. Naval.
		8075	−24	214	−3	24	42	10		
		8075	−14	224	+3	16	12	7		
		8075	−10	228	−1	11	170	7		
		8077	+44	282	+13	48	6	4		
		8078	+58	296	−8	58	61	5		
				(238)	(−4)		412	36		

POSITIONS, AREAS, AND COUNTS OF SUN SPOTS FOR MAY 1941—Continued

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
	h. m.		°	°	°	°				
May 2	10 26	8079	−56	169	+17	60	121	3	VG	U. S. Naval.
		8075	+3	228	−1	4	145	8		
		8077	+57	282	+13	59	6	4		
		8078	+70	295	−8	70	18	4		
				(225)	(−4)		290	19		
May 3	10 59	8081	−42	170	+17	47	48	10	F	Do.
		8079	−41	171	+16	45	145	1		
		8075	+3	215	−3	3	48	6		
		8075	+16	228	−1	16	145	9		
		8080	+53	265	+13	56	6	1		
				(212)	(−4)		392	27		
May 4	12 2	8081	−28	170	+18	35	97	14	G	Mt. Wilson.
		8079	−27	171	+17	34	109	1		
		8075	+16	214	−4	16	48	3		
		8075	+29	227	−1	29	145	12		
				(198)	(−4)		399	30		
May 5	13 35	(*)	−41	143	−6	41	24	3	VG	U.S. Naval.
		8081	−15	169	+18	26	97	22		
		8079	−14	170	+17	25	97	1		
		8075	+30	214	−4	30	24	3		
		8075	+44	228	−1	44	73	8		
				(184)	(−4)		315	37		
May 6	11 46	8081	−4	168	+20	24	12	5	G	Do.
		8081	−2	170	+18	22	73	14		
		8079	−2	170	+17	21	73	3		
		8075	+43	215	−3	43	36	6		
		(*)	+45	217	+16	50	6	1		
		8075	+57	229	−1	57	48	6		
				(172)	(−4)		248	35		
May 7	11 14	8081	+12	171	+18	24	61	9	G	Mt. Wilson.
		8079	+12	171	+17	23	61	3		
				(159)	(−3)		122	12		
May 8	10 57	8081	+26	172	+18	33	48	6	G	U. S. Naval.
		8079	+26	172	+17	22	36	2		
				(146)	(1−3)		84	8		
May 9	14 7	8084	−78	53	+23	79	194	3	G	Do.
		8083	−7	124	−5	7	12	3		
		8082	−2	129	−11	9	12	4		
		8081	+40	171	+17	44	6	3		
				(131)	(−3)		224	13		
May 10	11 26	8084	−75	44	+24	76	242	1	VG	Do.
		8084	−65	54	+23	68	194	6		
		8085	−23	96	+13	28	48	7		
		(*)	−13	106	+6	16	6	5		
				(119)	(−3)		490	19		
May 11	12 7	8084	−61	44	+24	66	194	1	F	Do.
		8084	−51	54	+22	56	145	3		
		8085	−9	96	+13	18	97	7		
		8086	+45	150	−4	45	24	4		
				(105)	(−3)		460	15		
May 12	11 11	8084	−48	45	+24	54	121	6	G	Do
		8084	−38	55	+22	45	97	4		
		8085	+4	97	+13	16	48	4		
		8086	+57	150	−3	57	24	3		
				(93)	(−3)		290	17		
May 13	11 27	8084	−36	43	+24	44	97	8	G	Do.
		8084	−23	56	+22	34	73	1		
		8085	+17	96	+13	23	291	1		
				(79)	(−3)		461	10		
May 14	13 2	8084	−22	43	+23	35	73	6	VG	Do.
		8084	−11	54	+22	26	42	2		
		8085	+29	94	+13	33	6	1		
				(65)	(−3)		121	9		
May 15	11 12	8087	−75	338	−5	75	97	1	G	Mt. Wilson.
		8084	−9	44	+25	30	24	7		
		8084	−8	45	+23	28	48	1		
				(53)	(−3)		169	9		
1939 May 16	13 2	8087	−61	338	−5	61	97	1	G	U. S. Naval.
		8089	−37	2	−10	38	12	4		
		8084	+7	46	+25	28	61	4		
		8084	+13	52	+26	30	12	3		
		8088	+51	90	+7	52	12	2		
				(39)	(−2)		−194	14		
May 17	11 16	8090	−64	323	+6	65	12	3	VG	
		8087	−46	341	−5	46	97	1		
		8089	−22	5	−10	23	12	3		
		(*)	+17	44	−2	17	12	2		
		8084	+19	46	+26	34	48	8		
		8088	+64	91	+9	66	12	4		
				(27)	(−2)		193	21		
May 18	14 11	8087	−30	342	−5	30	73	1	P	Mt. Wilson.
		8084	+36	48	+25	44	24	1		
				(12)	(−2)		97	2		
May 19	12 6	8093	−35	325	−6	35	12	2	G	U. S. Naval.
		8092	−26	334	−17	30	48	5		
		8091	−18	342	−9	20	12	2		
		8087	−18	342	−5	19	61	5		
		8084	+47	47	+25	53	12	2		
				(360)	(−2)		145	16		
May 20	11 53	8094	−32	315	−12	33	97	9	G	Do.
		8092	−13	334	−17	20	97	11		
		8087	−7	340	−5	7	12	4		
		8087	−5	342	−5	6	36	2		
				(347)	(−2)		242	26		
May 21	11 56	8094	−19	314	−11	21	36	5	G	Do.
		8092	0	333	−17	15	145	11		
		8087	+7	340	−6	15	24	4		
				(333)	(−2)		205	20		
May 22	10 46	8095	−58	263	+7	59	24	6	G	Do.
		8097	−29	292	−10	30	42	8		
		8094	−5	316	−10	9	6	1		
		8096	+6	327	−8	9	6	3		
		8092	+13	334	−17	20	97	10		
		8087	+22	343	−6	23	24	3		
				(321)	(−2)		199	31		
May 23	11 28	8095	−50	257	+7	50	36	4	G	Do.
		8095	−44	263	+7	45	73	12		
		8095	−41	266	+6	42	12	4		
		8097	−14	293	−10	16	121	15		
		8096	+20	327	−9	21	6	2		
		8092	+28	335	−16	31	42	5		
				(307)	(−2)		290	42		
May 24	11 12	8095	−29	265	+7	30	73	13	VG	Do.
		8097	0	294	−10	8	97	16		
		8096	+35	329	−9	36	48	6		
		8092	+45	339	−15	47	24	4		
				(294)	(−2)		242	39		
May 25	8 42	8095	−17	265	+7	20	73	16	VG	Mt. Wilson.
		8097	+14	296	−9	15	97	5		
				(282)	(−1)		170	21		
May 26	11 6	(*)	−60	208	+11	61	24	1	F	U.S. Naval.
		8095	−2	266	+7	8	73	6		
		8097	+32	300	−9	33	73	3		
				(268)	(−1)		170	10		
May 27	10 56	8095	+10	264	+7	13	36	4	VG	Do.
		8097	+45	299	−9	46	61	3		
		8096	+77	331	−7	77	6	1		
				(254)	(−1)		103	8		
May 28	11 35	(*)	−2	239	−2	12	12	4	VG	Do.
		8095	+23	264	+7	24	12	1		
		8097	+59	300	−9	59	18	2		
				(241)	(−1)		42	7		

*=Not numbered.

POSITIONS, AREAS, AND COUNTS OF SUN SPOTS FOR MAY 1941—Continued

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
	h. m.		°	°	°	°				
May 29	11 22	(*)	−57	171	−8	57	12	1	VG	U. S. Naval.
				(228)	(−1)		12	1		
May 30	15 17	8099	−77	135	−6	77	73	1	F	Do.
		8098	−72	140	−18	72	48	1		
		8098	−61	151	−18	62	121	1		
				(212)	(−1)		242	3		
May 31	11 10	8099	−65	136	−6	65	73	5	F	Mt. Wilson.
		8098	−60	141	−18	61	48	3		
		8098	−50	151	−18	52	121	9		
				(201)	(−1)		242	17		

Mean daily area for 31 days ------ =234

*=not numbered.
VG=very good; G=good; F=fair; P=poor.

PROVISIONAL RELATIVE SUNSPOT NUMBERS FOR APRIL 1941

[Based on observations at Zurich and Locarno. Data furnished through the courtesy of Prof. W. Brunner, Eidgenössische Sternwarte, Zurich, Switzerland]

April 1941	Relative numbers	April 1941	Relative numbers	April 1941	Relative numbers
1	35	11	59	21	20
2	26	12	46	22	20
3	21	13	*a* 41	23	*Mc* 36
4	23	14	30	24	**a* 27
5	*d* —	15	17	25	
6	*d* —	16	16	26	**d* 50
7	**d* 39	17	*Wc* 31	27	35
8	41	18	*d* 29	28	43
9	51	19	25	29	43
10	51	20	18	30	*Wc* 41

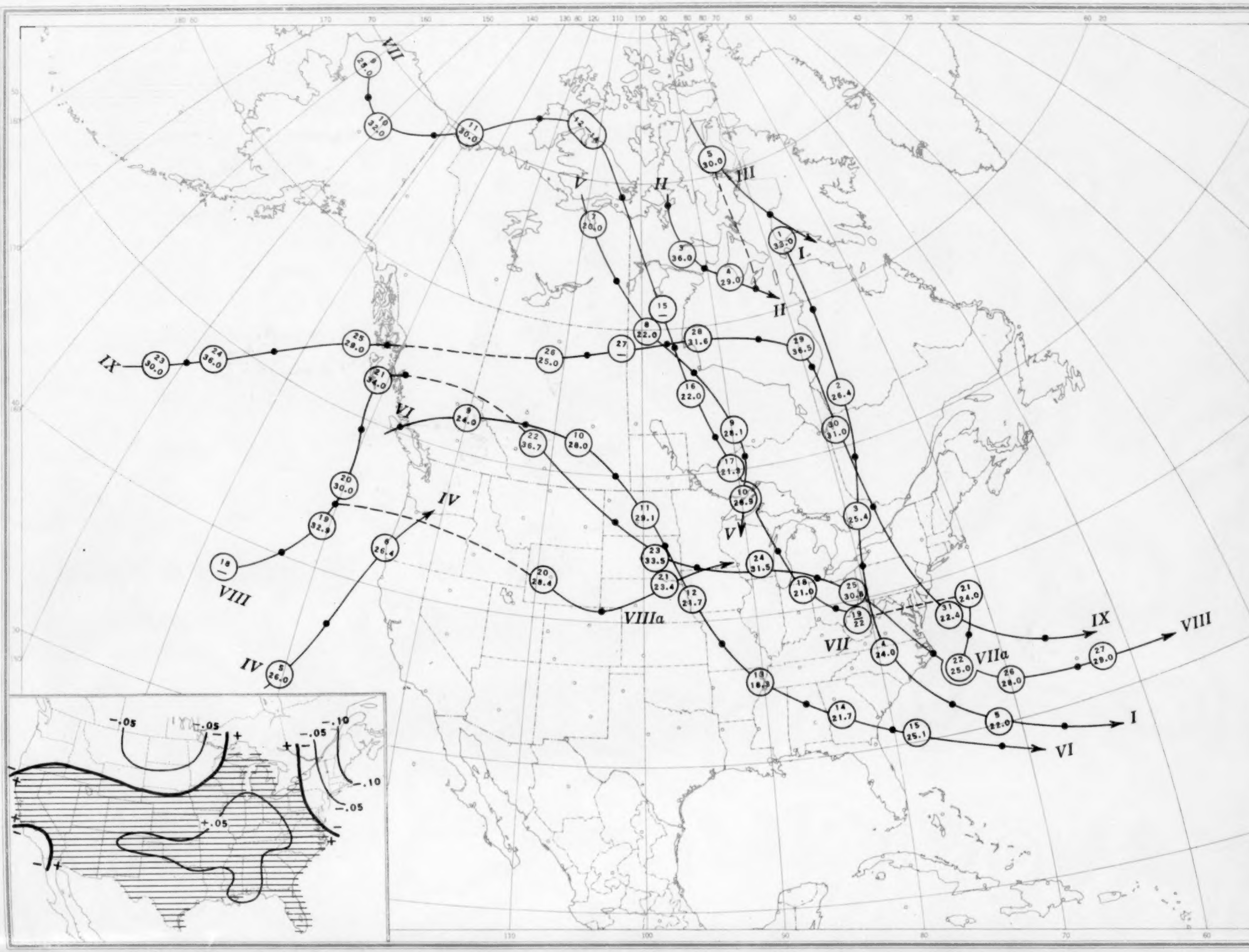
Mean, 27 days=33.9

*=Observed at Locarno.
a=Passage of an average-sized group through the central meridian.
b=Passage of a large group through the central meridian.
c=New formation of a group developing into a middle-sized or large center of activity: *E*, on the eastern part of the sun's disk; *W*, on the western part; *M*, in the central-circle zone.
d=Entrance of a large or average-sized center of activity on the east limb.

Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, May 1941

Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, May 1941

Chart II. Tracks of Centers of Anticyclones, May 1941. (Inset) Departure of Monthly Mean Pressure from Normal



Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 7:30 p. m. (75th meridian time).

Chart III. Tracks of Centers of Cyclones, May 1941. (Inset) Change in Mean Pressure from Preceding Mont

Chart III. Tracks of Centers of Cyclones, May 1941. (Inset) Change in Mean Pressure from Preceding Month

Circle indicates position of cyclone at 7:30 a. m. (75th meridian time), with barometric reading. Dot indicates position of cyclone at 7:30 p. m. (75th meridian time).

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, May 1941

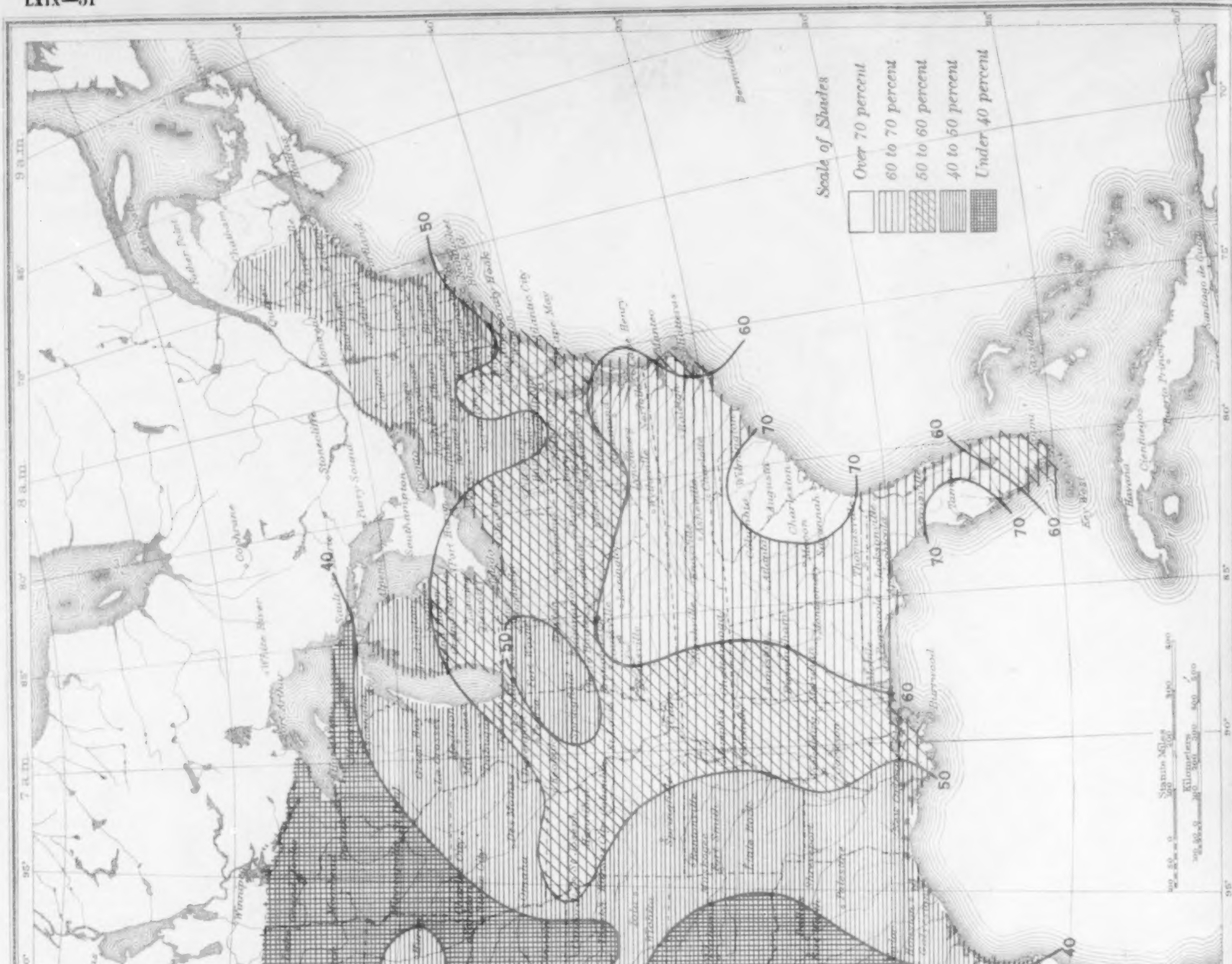


Chart V. Total Precipitation, Inches, May 1941. (Inset) Departure of Precipitation from Normal

Chart V. Total Precipitation, Inches, May 1941. (Inset) Departure of Precipitation from Normal

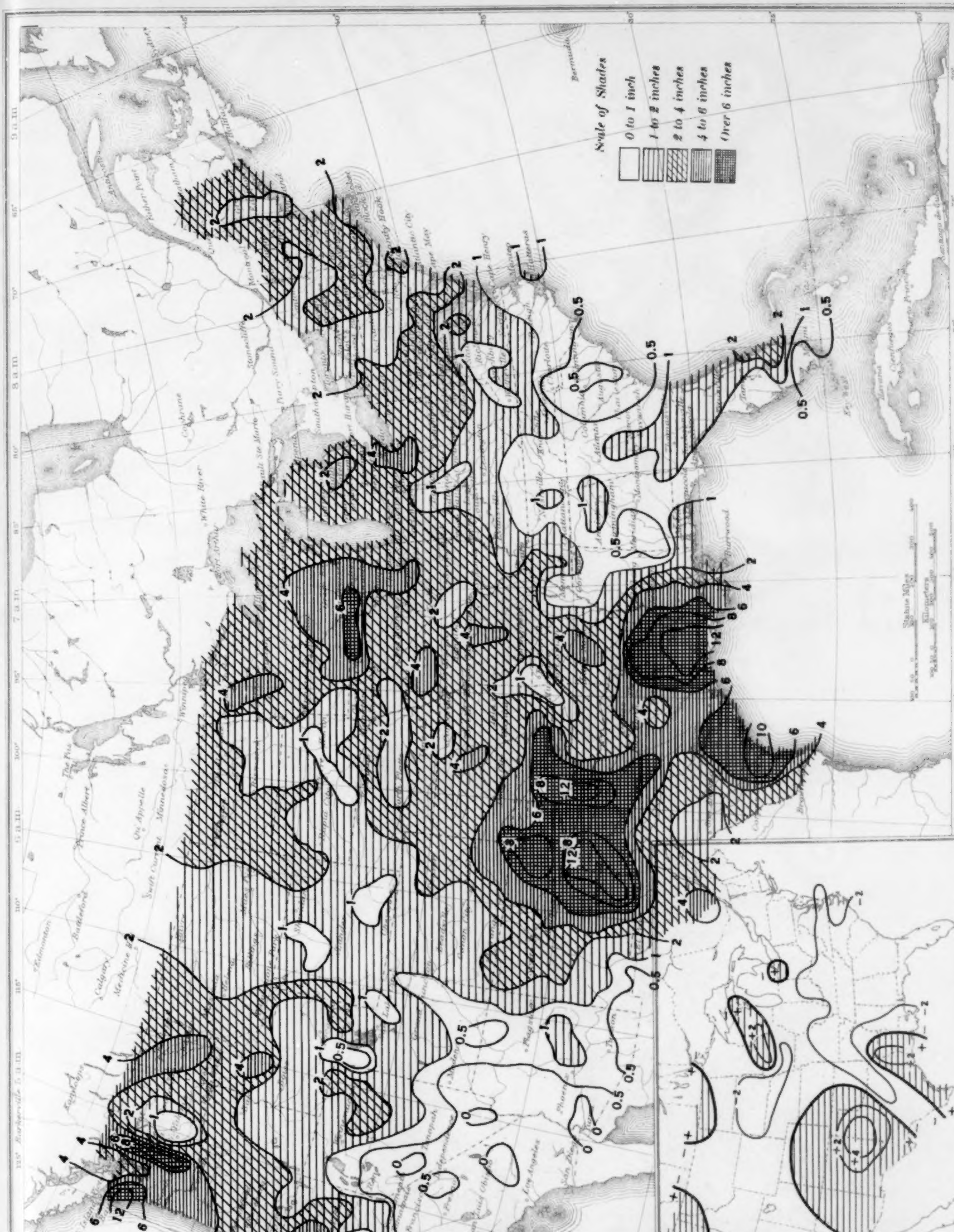


Chart VI. Isobars at Sea Level and Isotherms at Surface; Prevailing Winds, May 1941

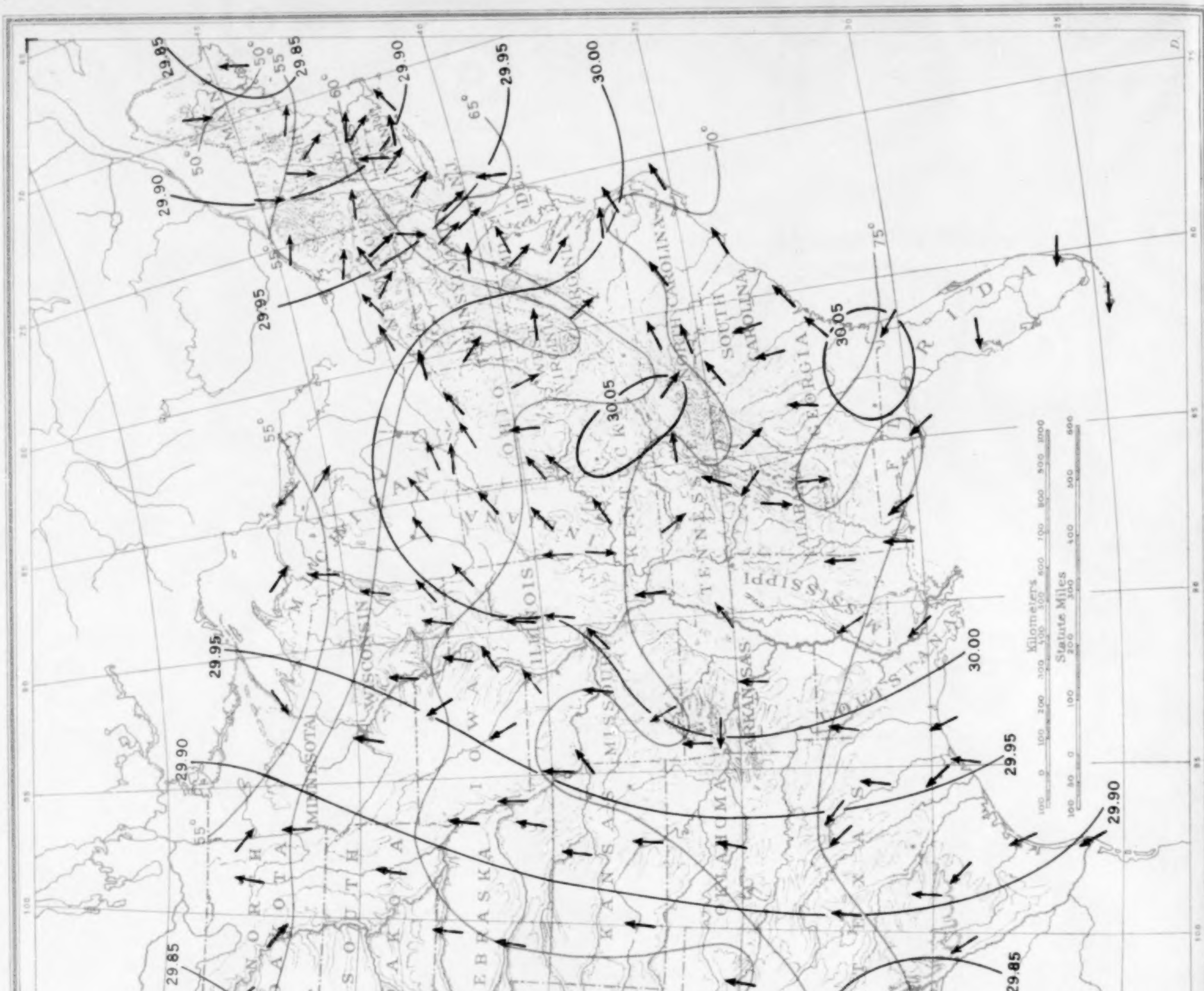
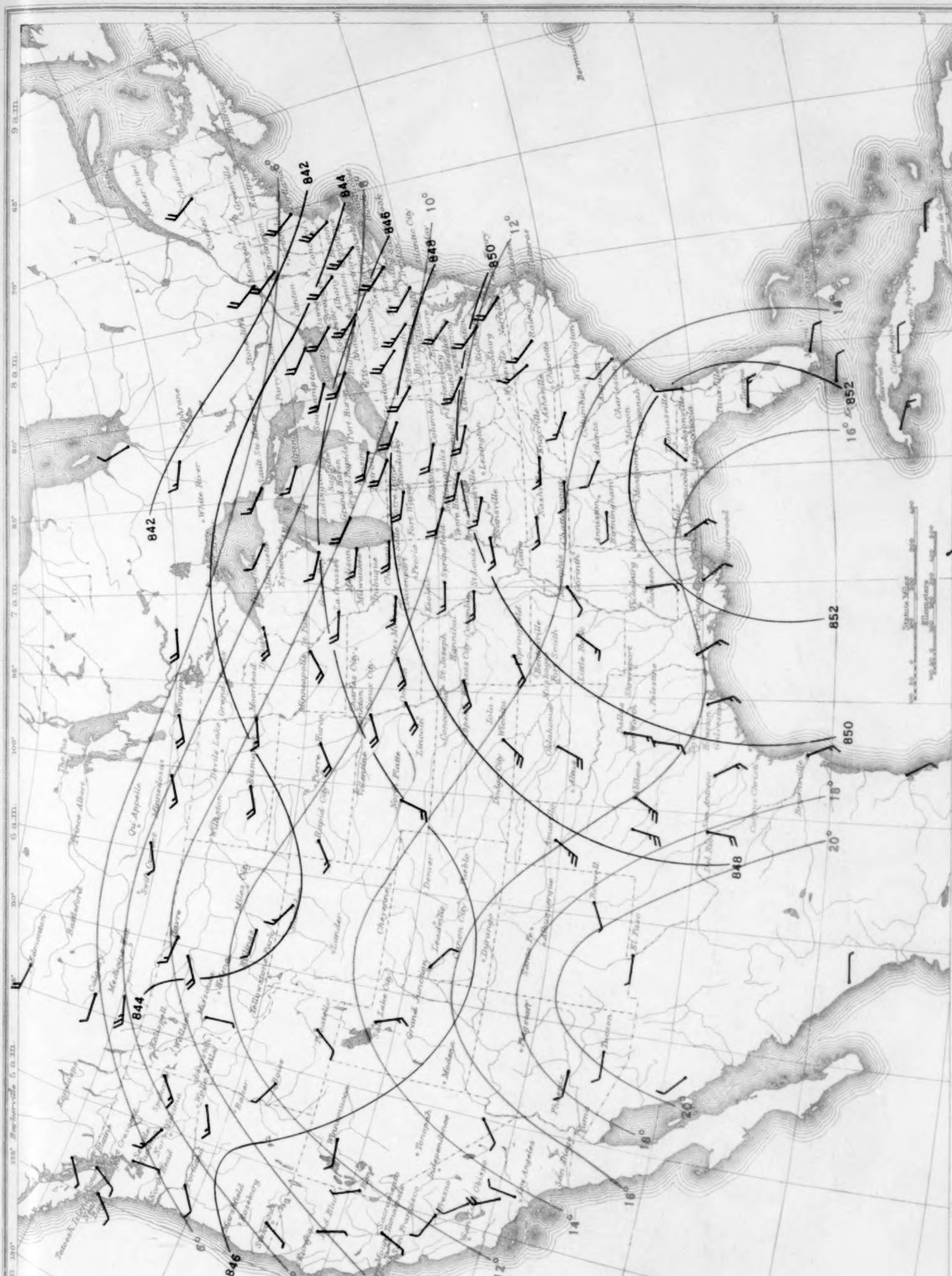


Chart VIII. Isobars (mb) for 1,524 Meters (5,000 ft.) and Isotherms (°C.) and Resultant Winds for 1,500 Meters (m. s. l.) May 1941

Isobars and isotherms based on radiosonde observations at 12:30 a. m. (E. S. T.) and winds based on pilot-balloon observations at 5:00 a. m. (E. S. T.).



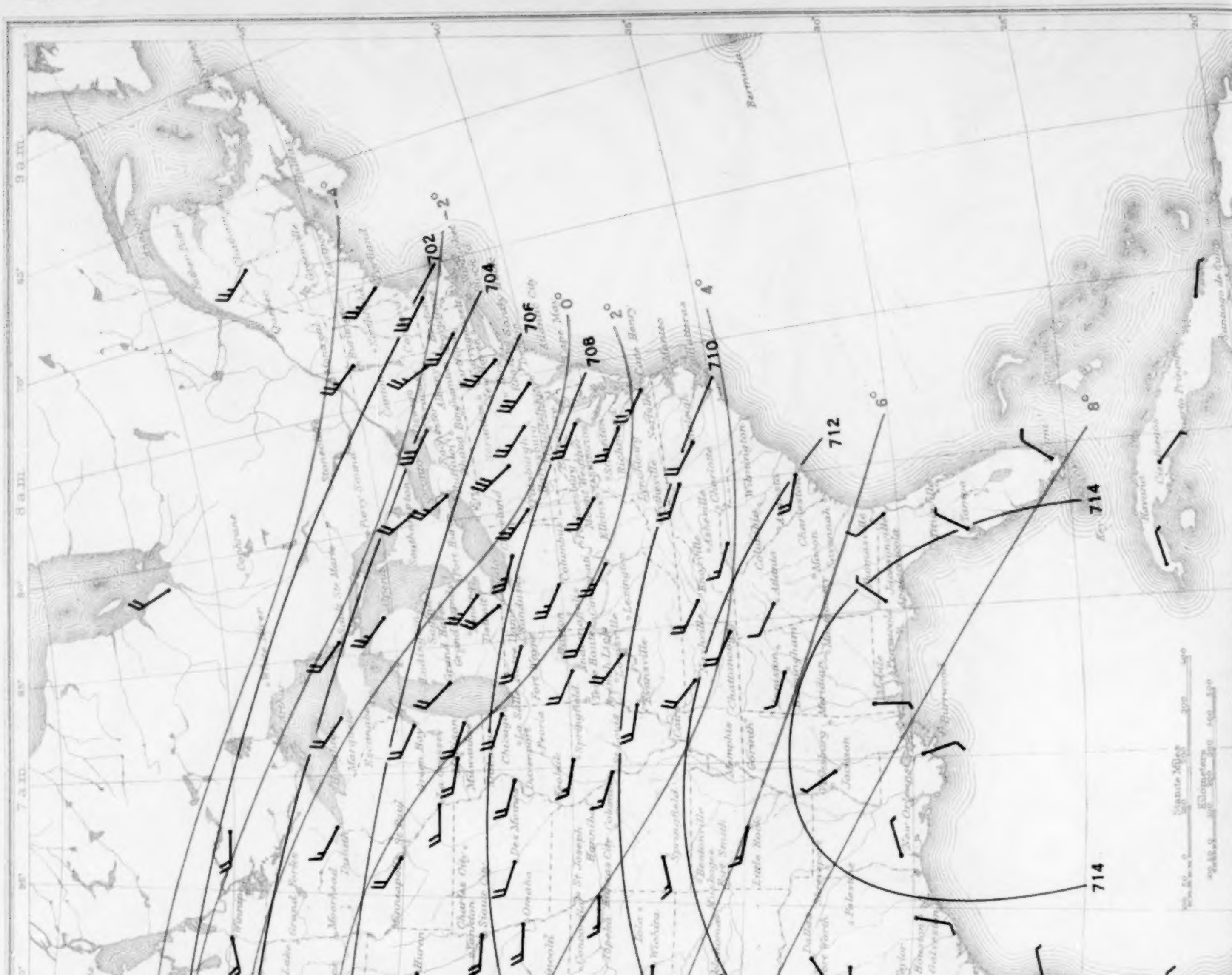


Chart IX. Isobars (mb) Isotherms (°C.) 1:00 a.m. (E.S.T) and Resultant Winds 5:00 a.m. (E.S.T.) for 3,000 Meters (m.s.l.) May 1941

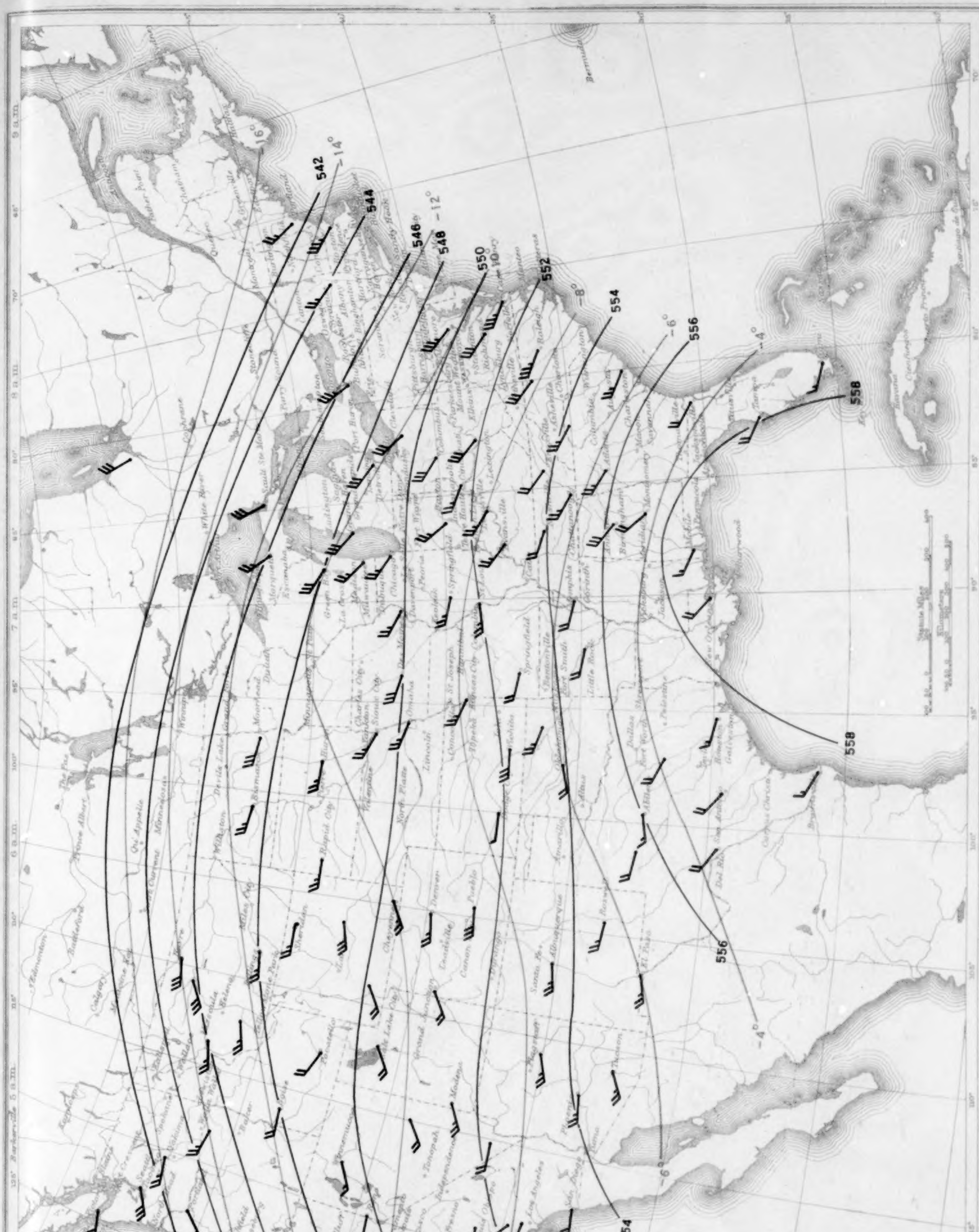


Chart X. Isobars (mb) Isotherms (°C.) 1:00 a.m. (E.S.T.) and Resultant Winds 5:00 p.m. (E.S.T.) for 5,000 Meters (m.s.l.) May 1941

Chart XI. Isobars (mb) Isotherms (°C.) 1:00 a.m. (E. S. T.) and Resultant Winds 5:00 p.m. (E. S. T.) for 10,000 Meters (m. s. l.) May 1941